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A New Iron-Ore Beneficiation Project

A NEW PROJECT that has for its object the utilization of a large deposit of iron ore in the Lake Superior district is now in its early stages of development. This deposit, the ore of which must be concentrated, occurs on the so-called Mattewin range, in Ontario, about 40 miles west of Fort William. Two features make the venture especially interesting. First, it is in Canada, where the development of any considerable resource of iron ore will be a matter of economic importance to the Dominion. Second, it is a sintering project that in its various aspects is reminiscent of the Mesabi Iron Co., at Babbitt.

The tract of land in which the ore occurs lies along the main line of the Canadian National Railways in a region that for many miles on either side brings no revenue to the railroad. The ore is a magnetite, and as far as known at the present time averages about 38 per cent in iron. It outcrops massively and over a large area, in places rising to heights of 200 to 300 ft. The ore is deep-seated and of considerable width. Drill holes 1,000 ft. in depth have failed to show the bottom of the lenses. Those who are interested in the project believe that ultimately the tonnage in the deposit will prove to be very large. However, it will be necessary to do further drilling to demonstrate the quality and quantity of ore and to make further metallurgical tests before the good results thus far obtained can be counted upon for the future.

Tests made last summer at the University of Minnesota, on a few tons of ore from surface trenches, show that less than 2½ tons of the magnetite need be mined or quarried and less than 2 tons ground to 100 mesh to produce a ton of concentrate assaying 64.99 per cent iron, 8.3 per cent silica, low in phosphorus and without sulphur or titanium. The formation, it is asserted, is not akin to that at Atikokan, 90 miles further west, which carries considerable sulphur, or to the deposits of Cook County, Minn., 50 miles to the southwest, where titanium is present. Rather, it is said to be more nearly like the Vermilion and Marquette formations.

The treatment planned for the ore, if further tests confirm the results of the experiments already made, will be somewhat similar to that given the taconite ore at Babbitt, though simpler. The ore itself is softer and breaks smaller with powder in the quarry. In reporting on the experiments made at the University of Minnesota, E. W. Davis, superintendent of the State Experiment Station there, has said:

> "The tests show the possibility of removing a certain amount of low-grade tailing by coarse, dry cobbing. . . . Tube tests were made on fine ground material. While these tests were on a small scale, it has been found in the past that the results of these tube tests do indicate quite accurately the possibilities of magnetic separation at finer sizes. . . . While the results of these small-scale, fine-grinding tests are not sufficient to be used as a basis for detailed figures, it is possible to see quite definitely that the utilization of this deposit lies in the development of a plant in which the ore is crushed to approximately 100 mesh. With such a plant a very high-grade merchantable ore can be produced."

Because of the location of the deposit, the project will have certain advantages that it would not enjoy were it in Minnesota. Taxes for one thing will be very much less. Further, it will enjoy a bounty of ½c. for each unit of iron in the concentrate for a ten-year period starting August, 1925. Besides these advantages inherent in the location across the border, there are others. There will be no royalties to pay, those interested in the venture holding the fee of the various properties. Another is that the prospective mill site discharges directly on Canadian National right-of-way, only 40 miles from the shipping point at Fort William, on Lake Superior. All these facts, coupled with the belief of the promoters that they will have no difficulty in making a sinter of 65 per cent grade, which is 13 units better than the average Minnesota ore that is sent to the furnaces, and which in other respects is equivalent to Old Range bessemer ore, are promising for the future.

Any effort to concentrate magnetite ores in Canada needs all the help it can secure. An iron-ore supply in western Ontario will be of great advantage to the province as well as the Dominion. Undoubtedly the venture will be extremely costly. The project is essentially a Canadian deal, depending in part on the promised subsidy and on the possibility of obtaining further government aid. Under the circumstances, Canadian furnaces will no doubt have first call on the sintered product, and if it proves to be of the grade forecast they will be sure to want it. No longer is the iron-ore industry so skeptical of beneficiation as was the case some years ago. Though for the moment shut down, the Babbitt project has shown what can be done. Mistakes made can be avoided, and with more advantageous conditions successful operation may be attained.

A Century of Railroading

A CENTURY AGO the railroad as an economic factor in the world's commerce was unknown. Today the railroads form a steel network of 250,000 miles of main lines in the United States—enough to encircle the globe ten times. The one-hundredth anniversary of the birth of the American railways will be celebrated today (April 17) at Albany, N. Y., its birthplace. The Mohawk & Hudson Railroad Co. was granted a charter on April 17, 1826, to operate a steam railroad between Albany and Schenectady (17 miles). Over this line the De Witt Clinton, an American-made steam locomotive, began its successful career Aug. 9, 1831. The tracks over which it traveled were made of strap iron nailed to wooden stringers. The space between the rails was filled in in such a manner as to form a roadway for horses in the event of the failure of the locomotive. On level roadways a speed of 30 miles per hour was attained but not maintained.

In those early days the time required to travel from New York to Boston was two long, dreary days by stage coach, and the freight rate from Philadelphia to Pittsburgh by horse-drawn wagons was $140 per ton. During the twelve years following the maiden trip of the De Witt Clinton, ten railroad companies were organized to operate between Albany and Buffalo, and in 1843 it required twenty-five hours to make the trip, changing to the ten different roads, and buying a ticket at each transfer point. The merger of these ten companies in 1853 formed the nucleus of the New York Central Railway, and in 1869 the New York Central and the Hudson River Railroad consolidated, forming a continuous line from New York City to Buffalo, an overnight trip.

With the provision of railroad transportation, commerce grew; the forests were converted into lumber and entered into the construction of great industrial centers. As commerce grew and interchange in communication developed, the mines of the West, South, and North were called upon for their gold, silver, lead, zinc, copper, coal, and iron, in quantities undreamed of in earlier years. The great hinterland beyond the Appalachian Mountain system developed rapidly with the completion of transcontinental lines, until now the products of the mines, forests, and farms are transported thousands of miles to great industrial centers, to be converted into implements, tools, and fabrics of commerce. More than 50 per cent of the freight traffic originates at the mines, with agriculture running a close second.

In 1925 the freight revenue of the railroads was $4,546,600,000, representing 414,139,835,000 ton-miles at 1.098c. per ton-mile. The actual tonnage moved in 1925 was 2,280,000,000. In addition to this tonnage, the passenger revenue in 1925 amounted to $1,055,273,000.

The Arsenic Outlook

OF THE TOTAL AREA of cotton-planted land in the South, 85 per cent, according to *Commerce Monthly*, is infested with boll weevil, whereas on only 5 per cent have the plants ever been treated with calcium arsenate. The manufacture of this chemical, generally conceded to be the only efficient protection against the ravages of the weevil, has in recent years accounted for the large demand for arsenious oxide or white arsenic, produced usually as a byproduct in the smelting of lead and copper ores.

In 1923 the consumption of calcium arsenate was about 32,000,000 lb. The supply was virtually exhausted and in some instances 40c. per pound was paid for it. That was the peak year. In 1924 the summer was dry and hot and the depredations of the weevil were insignificant. A cold winter followed by another exceptionally dry crop-raising season, over most of the cotton belt, almost eliminated the weevil as a disturbing factor last year. This, coupled with the rapid expansion in plant capacity for the production of white arsenic, spoiled the market. The smelting companies have huge stocks of barreled oxide on hand in this country and in Mexico, and are equipped to make a large current production. Sales, however, are small and few, and sellers can be found at 3½c. per pound.

Probably the wisest course for the cotton raiser would be to treat his plants every year, whether it happened to be a "bad" season or not. By so doing he would be taking precautions for the next year and would probably save or make money in the long run. Naturally, he does not do this. He buys calcium arsenate—if he can find the money—only when the need is pressing. In the last two years fortune has been with the cotton planter; Providence, not his own efforts or foresight, has helped him. The past winter has not been severe, and if rain is plentiful during the spring and summer the weevil pest may flourish. Leaders in the cotton industry have officially predicted that the coming season will see more trouble from this source than ever before. There may yet be a market this summer for calcium arsenate and consequently for the white arsenic that the smelting companies have been husbanding so carefully, even if against their will.

Essentials of the Ore Magma Theory

THE essentials of the Ore Magma Theory, announced by J. E. Spurr in 1923, were put into an editorial in the *Engineering and Mining Journal-Press* of May 30, 1925, which is quoted below in full:

"The origin of gold-quartz veins as a variation of pegmatites has been argued as far back as 1861 by Thomas Belt, the distinguished English mining engineer and naturalist, but the idea was ignored by geologists. These views were independently advanced by J. E. Spurr in 1898 as an explanation for the Yukon gold-quartz veins. This conception, however, was of highly heated water as the end product of granitic differentiation, this magmatic water being the ore solution. But in 1905, studying similar gold-quartz veins in Nevada, Spurr pictured the ore solution in this case as concentrated and the gold-quartz as intrusive, just as pegmatites are intrusive. In 1907 the Zonal Theory of Spurr showed the interrelation of the different metals. This theory postulated that in the final pegmatitic residue of a magma many metals are present, and that with decreasing temperature each is separately precipitated, the deep-seated gold-quartz ores representing one of the deepest zones, close to the pegmatites. This theory, now generally accepted, pictured at first the ore solutions essentially as magmatic waters, except in the case of certain gold-quartz veins and ore-bearing pegmatites. The Ore Magma Theory, proposed in 1923, substitued, as above stated: for magmatic waters, highly concentrated and dense magmatic residues; for long circulation, a definite stage of injection; for fissures already open, the forcing open of fissures in many cases by the ore magma; for slow accretion of precipitation, simple crystallization from the injected ore magma."

This theory has been accepted by a large part of the geological world; and by others has met with partial, even if not always open, acceptance.

Thus Prof. Waldemar Lindgren, in the March-April (1926) issue of *Economic Geology*, diagnoses the origin of the veins of Caracoles, Bolivia: "There has been no injection of an 'ore magma.' There has been an *injection of highly mobile aqueous solutions*,[1] etc." In the italicized phrase, Professor Lindgren has, in agreement with the ore magma theory, substituted "injection' for the time-honored "circulation," and "highly mobile aqueous solutions" for the old "magmatic waters and gases." In short, he appears to accept much of the ore magma theory "in principle," although objecting to the name, which is an unessential point.

Similarly, Mr. H. C. Boydell, an assistant of Professor Lindgren, in the same number, criticising the paper of J. E. Spurr on "The Camp Bird Compound Veindike" in *Economic Geology* of March-April, 1925, advances an explanation of the ore precipitation in that vein, which seems to assume stagnant solutions in the vein fissure during prolonged chemical reactions. He, too, apparently accepts crystallization from injected ore solutions

[1]Italicized by the Editor.

instead of the conception of gradual deposition from circulating waters which obtained previous to the advancement of the ore magma theory. He, too, apparently accepts in principle; although, again, denying the implication. His explanation, he says, does not require the "assumption of the existence of an ore magma, other than the usual mineralizing solutions." What are, then, these "usual mineralizing solutions"? Are they not ore magmas? Indeed, on an earlier page, Mr. Boydell so states, observing that "ore magma" is merely "Mr. Spurr's own term" for "residual mother liquors or solutions."

Diatomite and Diatomaceous Earth

IT IS NOTED with no little regret that Mr. C. W. Davis, in a recent serial publication of the Bureau of Mines, makes use of the term "diatomaceous earth" in place of diatomite. "Diatomaceous earth" is a misnomer, for the mineral is rarely in earthy form unless prepared by crushing and grinding, and the purest varieties are massive. It is true that the term "diatomaceous earth" has been used to a considerable extent, but this was in the period before the material became of importance. It is now used on an extensive scale for filtering, heat insulation and for a variety of purposes. After discussion the term *diatomite* was adopted by the *Engineering and Mining Journal-Press* as a concise name that avoided the implied inaccuracy of the former term. Diatomite is recognized by Diana and conforms closely to a distinct mineral species, a variety of opal, although its origin is organic and its silica and water content more or less variable.

Secondary Enrichment of Tin Ores

THE PAPER on Bolivian tin deposits, by Mr. Koeberlin, which appears in this issue, is of real economic and scientific interest. His chief point, and one based upon years of study in the field, is that there has been a highly important degree of concentration of tin ores, beneath the outcrops and in large part directly beneath the zone of oxidation, by what is commonly called secondary enrichment. This enrichment has apparently dissolved and concentrated in a rich secondary zone, following the surface, the prevailing oxide of tin, cassiterite, well known as one of the most resistant of minerals to oxidation—as is shown, among other things, by its important occurrence in tin placers.

The data which Mr. Koeberlin cites, however, are impressive; and one is impelled to respect his conclusions, that cassiterite has been dissolved and reprecipitated as cassiterite in the secondary zone beneath the oxidized zone, on a large and commercially very important scale. Mr. Koeberlin does not attempt to explain the chemistry of this process; he has followed the true geological method of ascertaining from accumulated geological facts, by the inductive method of reasoning, what has taken place—leaving for the future the elucidation of the reason. His conclusion, as he indicates, is of maximum interest as applied to the future development and financing of Bolivia's tin mines.

Accepting the facts as set forth, some inkling is given which may help to explain this apparent anomalous condition of easy solubility and redeposition of a mineral known to be, in general, highly refractory to atmospheric solvents. While this free secondary concentration may exist in other tin districts of the world, the description of it by Mr. Koeberlin is not matched by described data elsewhere. In this connection it is well to remember that many of the Bolivian deposits are peculiar chemically, in the important occurrence of tin as sulphide as well as oxide, and in the intimate association of tin with other metals, such as silver, lead, zinc, and copper, with antimony and arsenic, in complex minerals. It may be significant that the cases of notable secondary enrichment cited show this association of cassiterite with other metals. Thus in the case of the San Fermin vein, cassiterite is associated with zinc blende and pyrite, and other metallic minerals; and leaching and concentrated redeposition have apparently been marked. Another district where secondary enrichment appears to have been very important is Oruro, a silver-tin district—here both tin and silver are concentrated below the oxidized zone. Pyrite and blende, with other metallic minerals, accompany the tin.

On the other hand, some of the tin veins apparently have not experienced this process—that is, in them cassiterite has not been attacked by oxidation and the other chemical influences of ground-waters, although under identical atmospheric and ground-water conditions as the other veins where this action has been apparently thorough. Such a chemically stable vein is the Colorada, at Chocaya. Speculating as to the causes of its stability, Mr. Koeberlin expresses the opinion that it may be due "perhaps to the absence of minerals with contributary action in the solution of cassiterite. Bearing on this point, it may be said that copper is rarely found in this vein."

Indeed, we may suspect, from the above, that the unusual solubility of cassiterite in the cases described is dependent upon close association with certain other metallic minerals, whether it be of copper or some combination of two or more. Possibly plain chemical reactions may eventually be found to account for the phenomenon. There is, also, the somewhat more attractive theory that electrochemistry may furnish the clew. That electrolytic action is important in the oxidizing of ore deposits is well known: One of the recognized electrical methods of ore finding—that of Schlumberger—is based upon the activity of electric currents so generated, and their detection by the galvanometer. That the stability of minerals in the bath formed by the superficial ground-water depends, to a degree as yet not evaluated, upon associated minerals, has been clearly indicated by such experiments as those of Gottshalk and Buehler.[1]

The Rodent Engineer

ON ANOTHER PAGE a scout reports discovering the profession of Insurance Engineer, and he sends us the advertisement of a firm of Liquidating Engineers—who are not Reclamation nor yet Hydraulic Engineers, but sell real estate. We may add also that we receive circulars from Investment Engineers—none other than a prominent firm in Boston.

But the prize to date goes to a scout who introduced us to the profession of Rodent Engineering. The Rodent Engineer, who thus designates his business on his door, does business with rats—he exterminates them.

Altogether, it would look as if the struggle for the engineer to be recognized as a learned professional man was a losing one—he may in the end not resent being asked whether he is a locomotive or a stationary engineer, and be glad he is not suspected of being a rodent engineer.

[1] *Economic Geology*, Vol. VII, 1912, pp. 15-34.

Geologic Features of Bolivia's Tin-Bearing Veins

Evidence That Only a Process of Secondary Enrichment Can Account for the Origin of Many of the Deposits Thus Far Discovered

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LITERATURE dealing with the tin deposits of Bolivia is not very abundant. Thorough studies comparable with those made of most of the important mining districts in other parts of the world have rarely been attempted there. The engineer investigating tin veins in Bolivia does not have at his disposal a rich fund of published geologic data to draw upon, but must usually work out his problem from the beginning. For this reason a description of some of the geologic features having more direct economic bearing, observed by myself in the course of a professional experience extending over a period of years in this part of the world, may possibly be of some interest to other members of the profession, or perhaps contribute a little to our knowledge of the geology of tin deposits in general.

The genetic dependence of tin-bearing veins the world over upon the persilicic igneous rocks is well known, and the Bolivian tin veins are no exception to this rule. Previous to the development of the Bolivian deposits, it was thought that tin veins were restricted to granites or to the sedimentaries immediately overlying granitic masses; but in Bolivia these veins occur not only in granite but also in the fine-grained equivalents of this rock, quartz-porphyry, and rhyolite. However, the difference in these three igneous types is textural only and not mineralogic, and it is very likely that in Bolivia, in the tin belt, they all correspond to a single period of magmatic upheaval, probably late Tertiary. The belt in which the tin veins occur is about 600 km. long by 100 km. wide; and over all of this zone outcrops of the acidic igneous rocks occur, though not always in the immediate neighborhood of the tin veins. In the northern half of the strip these rocks are granite; in the southern, rhyolite-porphyry.

Two Groups: Normal Tin Veins and Tin-Silver Veins

The veins themselves may be roughly classified into two main groups: normal tin veins and tin-silver veins. All gradations exist between these two groups, the tin-silver veins passing, furthermore, into silver-lead-zinc veins, with tin occurring only in traces or not at all. The gradation of the veins from straight tin to straight silver, and to lead-zinc, runs parallel with the transition from granite in the north of the Bolivian mineral belt through the stages of quartz-porphyry and rhyolite going south up to the region of overlying andesite flows. This fact was well brought out by Miller and Singewald in their book "Mineral Deposits of South America," and the idea was further developed by Davy[1] in an excellent paper based on a microscopic study of representative ores from different parts of the Bolivian tin and tin-silver belt. Davy shows a gradual change from north to south in the mineralization of the tin veins, passing through successive stages as follows: Cassiterite and tourmaline type; cassiterite, quartz, and pyrite type; cassiterite, stannite, pyrite, and silver-bearing tetrahedrite type; and ending with the silver tetrahedrite, pyrite, sphalerite, galena, and chalcopyrite type, in which tin occurs only very sparingly or is entirely absent. These are Davy's outstanding types, omitting his minor subdivisions. As the series above set forth coincides approximately with the passing from granite to rhyolite, or, let us say, submergence of the granite core, Davy concludes that the change in mineralization of the veins corresponds with the temperature of deposition as evidenced by the character of the near-by genetically connected igneous rocks, be they granites solidifying under high pressure conditions or porphyries congealing at moderate depths. This interpretation does indeed adjust itself to many of the facts as observed in the field, and is, moreover, in accordance with the latter conceptions concerning the zonal arrangement of primary mineralization.

Field Criteria Upon Relative Importance of Veins

The nature of the inclosing or neighboring acidic igneous rocks is, however, only a rough thermometer with which to measure relative mineral deposition temperatures. Either in the case of granite walls or rhyolite porphyry walls, the rock must have been cold enough to admit of rupture; otherwise the deposit could not take the form of a vein. Davy[2], in trying to fit the Llallagua-Uncia ores into the scheme, rather strains the point by classifying the Llallagua porphyry as grading toward granitic types. It is no more of a granitic type than the Oruro rhyolite-porphyry, which incloses typical tin-silver veins, or the Chocaya porphyry, where the famous Animas tin-silver deposit occurs. The determinant factor is probably not so much the heat of the rock in which the minerals were deposited as the heat of the rock or reservoir from which the mineralizing solution or ore magma was expelled. The depth of the fracture tapping this source is an important consideration. Veins occurring in coarse-grained granite presumably were the shortest conduits to the high-temperature tin source, and it is natural that these veins should show a filling of high-temperature minerals like tourmaline and cassiterite. Such veins need not necessarily be formed on very profound

[1]Davy, W. Myron, "Bolivian Tin Silver Deposits." *Econ. Geol.*, Vol. XV., pp. 463-496; 1920.
[2]*Op. cit.*, p. 480.

fractures, since the source of their filling was near at hand. Veins occurring in the rhyolite porphyry or any rock distant from the granite core are farther removed from the sources of high-temperature minerals, but not so far from sources of lower-temperature minerals like those of the tin-silver group. These veins in turn need not necessarily be formed on far-reaching fractures when the filling consists of the lower-temperature tin-silver group. But (and this is one of the geologic points having a decided economic bearing which it is the object of this paper to emphasize) if a vein occurring in the porphyry or any other rock presumably distant from the granite core shows the high-temperature set of minerals to the exclusion of the lower-temperature series, it indicates that the vein is really important, having been formed on a profound fracture, or, let us say, master fissure. This is one of the reasons for the apparent anomaly of Llallagua. The country rocks are rhyolite porphyry and the intruded sedimentaries. It is probably far removed from the granite core; and its mineralization, by inference, should be of the tin-silver type. Instead of that, its primary mineral aggregate—cassiterite, quartz, arsenopyrite, and pyrite—is a distinctly high-temperature group, quite different from the tetrahedrite, cassiterite, stannite, and galena series common to the typical tin-silver veins.

FACTS observed in the field have impelled Mr. Koeberlin to the conclusion that solution of cassiterite in the tin veins and redeposition at lower levels, far from being a scientific curiosity of academic interest only, is a natural process of the most vital economic importance in Bolivia. He will be interested to hear from observers in other tin fields, especially in Australia, South Africa, and the Malay Peninsula, where climatic, topography, and mineralogic conditions are different. He hopes to call forth comment or bring out evidence from these regions that will tend either to corroborate or to negative the conclusions outlined by him in this article

At this mine, the San Fermin vein, which is probably the world's greatest tin vein, is formed on a fault fracture, the horizontal component alone of whose displacement amounts to about 500 meters. The enormous depth to which such a powerful fracture must extend before dying out may be imagined, and with it goes the potentiality of tapping a far-distant source of high-temperature minerals. Two systems of veins occur here. One is of the fault-vein type like the San Fermin. The other comprises very numerous veins varying in width from knife-edge to one meter. These latter veins seldom are continuous for more than 100 meters along the strike or along the dip, but thin out, ramify, and disappear. The vein material is attached closely to the walls, "frozen." There is no brecciation, and the walls are clean and firm. There is, furthermore, no relative displacement of the walls; one side can be matched with the other. Such veins are clearly contraction fissures. As they dip vertically and the fault-veins on the other hand are inclined 70 deg., with only a slight difference in strike, the fault-veins pick up the contraction-fissure veins as they go down in depth, mostly from the hanging-wall side.

A short synopsis of the primary tin-veins at Llallagua-Uncia would read something like this: "Numerous parallel contraction fissures formed at the time of cooling of the porphyry; later deep faulting, cutting and displacing these fissures; mineral solutions of ore magmas rising along the faults and fingering out into the fissures, many of which never reach the surface." These fissure veins thus act as bleeders to the fault-veins with regard to primary mineralization, but as feeders with respect to secondary enrichment. A cross-section through the two vein systems would appear something like the outline of a tree, the fault-veins forming the main branches and the contraction fissures the twigs. The fault-veins in turn join up among themselves, since the dips of some of them are opposite in direction to the others.

In this connection it should be noted that the fault-vein cross-section pattern is always a "Y," and not an "X" or an "N," notwithstanding the pre-mineral fault pattern might well be that of an "N," though not possibly an "X." At Llallagua it is probable that one of the fault-veins, most likely the San Fermin, will in depth ultimately pick up all of the others, thus forming the trunk of the tree. In trying to predict which one of such a system of veins will eventually be the trunk, I am inclined to favor the one showing the greatest pre-mineral fault displacement as being more likely to tap distant as well as nearby sources of ore magmas; or, following another line of reasoning, one dipping in the direction of the igneous vent rather than toward the sedimentaries.

In appraising the future possibilities of a vein in an unknown district, more confidence with regard to its persistence would be inspired by a vein which fills a fracture showing a large displacement than by one with a slight dislocation. Nevertheless, it is not always possible—it may even be said it is usually impossible—to get a direct stratigraphic or physiographic expression of land forms that will give a line on the magnitude of the fault. In the absence of such direct evidence, the mineralogic criterion that was suggested above may sometimes be of value. At Chocaya, for instance, the Colorada vein of the Compañia Oploca outcrops in a rhyolite porphyry, the tin oreshoot of which is over 1,000 meters long and is already developed to a depth of about 500 meters below the surface. There can be no question about the importance of the vein, but the physiography of the surface gives no clew as to the extent of the movement along the fracture it occupies. The vein-filling, however, is almost exclusively pyrite and cassiterite, a typical high-temperature combination. Yet the vein outcrops in rhyolite porphyry grading into tuffs. Furthermore, the very rich tin-silver vein in the neighboring Animas mine of the Aramayo company lies in this same body of porphyry. This latter vein is typical of the lower-temperature group characterized by the tetrahedrite-stannite formula. We thus have in the case of the Colorada vein (pyrite-cassiterite) a typical high-temperature vein at the same horizon as a low-temperature vein. To bring about this result the vein must have been formed on

a major far-reaching fracture passing through the porphyry zone and tapping the distant source of high-temperature minerals.

The Case of the Colorada Vein

The Colorada vein is cut off by the rich tin-silver vein of the Animas mine, the difference in strike being about 20 deg. This shows that the fault on which the tin-silver vein was formed was post-mineral with respect to the straight tin mineralization, but pre-mineral with respect to the tin-silver epoch. A few small patches of silver ore have indeed been found in the Colorada vein, which, as they lie apart from the straight tin ore, were probably introduced during the second epoch. Miller and Singewald[3] do not agree with Armas in that a silver mineralization may be superposed on a previous tin mineralization by reopening of the veins, yet it seems to be a not uncommon phenomenon, especially when, as in this case, a later tin-silver system of veins does not differ greatly in strike from an earlier straight tin system. Old fractures are readily reopened when the new force is nearly in the same direction.

Fig. 1—Hand specimen Colorada vein, Chocaya

Breccia fragments are shown surrounded by alternating bands of cassiterite and pyrite with an occasional band of quartz. 1, Breccia fragment. 2, Cassiterite bands. 3, Pyrite bands. 4, Floating pyrite crystals. 5, Quartz. Enlarged one and one-half times

So far only one tin vein has been developed in this district, but there are a number of tin-silver veins as well as silver-lead-zinc veins. Will these latter be as persistent along the strike and in depth as the tin vein? Perhaps not. They are too close to home. Any small fracture can be filled a short distance from the source. The relative frequency of the tin-silver and silver-lead veins compared with the straight tin veins is in itself significant. However, if a vein of the tin-silver group were to be found in a relatively higher horizon—let us say, for example, in a thick, later andesite capping covering the rhyolite porphyry zone—such a vein would inspire confidence, as it implies a distant source of mineralization, with the necessary corollary of a major fracture tapping this source.

Hence, in my opinion, one of the first points for the geologist to determine, in appraising an unknown tin vein in Bolivia, is the relative magnitude of dislocation in the fissure it occupies. Stratigraphic and physiographic criteria are the most positive and reliable, but in the absence of these, mineralogic considerations as outlined above may throw some light on the matter. The veins as a rule fit very well with Spurr's conception of veindikes, but it may be argued that a dislocation is not essential to forming a deep and long fissure as a container for the vein-filling; for, if the vein is a dike, we know of innumerable examples of wide and powerful dikes which have opened a way for themselves with but slight relative displacement of the walls, and there is no reason why an ore magma should not act in a like manner. However, the rock dike probably has the forces of a reservoir of magma of batholithic proportions back of it, while it is difficult to imagine like conditions in the case of ore magmas. In any event, although it is not proved that a vein may not open a passage for itself like some dikes, nevertheless a previously formed channel is a favorable factor, and the deeper and longer this channel the more auspicious an antecedent does it constitute for long life and persistence of the vein.

Secondary Enrichment—Attempts to Explain Origin of Deposits

Secondary enrichment of cassiterite veins is a matter which has frequently been touched upon in the literature dealing with tin deposits, but the subject is usually dismissed with a few cursory remarks about wood-tin, oxidation of stannite, removal of soluble gangue constituents, and the like. The drift of opinion has been, that although migration downward of tin in solution has been known to take place to a limited extent, the primary source of the tin in such cases was probably stannite or some other complex tin sulphide. It was thought that if solution of cassiterite took place at all, it would be on an insignificant scale, a scientific curiosity, of academic rather than economic interest. The enrichment of the oxidized zone in many Bolivian mines was ascribed to the oxidation of associated pyrite and its removal in solution as sulphate and also to its alteration into the less heavy mineral limonite. This process does undoubtedly account for some enrichment in the oxidized zone, but it does not tell the whole story, except perhaps in some exceptionally pyritic ores. Other far-fetched agencies were invoked to explain obvious manifestations of enrichment. It was suggested that the mechanical transportation of liberated cassiterite by meteoric waters percolating downward through the porous oxidized material of a vein might be a factor in producing enrichment; but such sifting action at the best is an exceedingly local phenomenon and is quite devoid of economic significance.

The only really adequate process that can commensurably account for most of the cases of enrichment of tin veins to be seen in the Bolivian tin belt is: Solution of cassiterite in the upper parts of the vein; downward percolation; redeposition as tin dioxide at lower levels. However, it is not surprising that most observers

[3] "Mineral Deposits of South America," pp. 97-98.

apparently are very reluctant to accept this explanation.

One need only picture to himself the placers of cassiterite, where this mineral is carried away many miles from its source, in the finest state of comminution, to become impressed with its extreme inertness and insolubility. The general tendency is to concede that tin existing in the form of stannite ($Cu_2Fe\ Sn)\ S_4$, frankeite ($Pb_9Sn_2Sb_2S_{12}$), teallite ($Pb\ Sn\ S_2$), and other complex sulphides can readily weather into soluble compounds, and from these be reprecipitated as secondary cassiterite. The idea of the oxidation of these sulphides and the solution of tin as a simple or mixed sulphate implies no violence to our preconceived notions, and is based on comparatively simple and well-known reactions. However, the fatal objection to this simple explanation is that, in most of the mines where enriched zones are especially marked, these sulphide minerals of tin do not occur in anywhere nearly like adequate quantities. Furthermore, the concentration of tin from a low-grade stannite vein into a rich zone of cassiterite would, in any event, involve many cycles of re-solution and redeposition parallel to erosion of the vein, the very second cycle of which series would already confront us with the condition of tin in the form of oxide.

Cassiterite Soluble Under Certain Conditions

That tin in this combination (cassiterite) is soluble under certain conditions occurring in nature is the conclusion at which I have arrived after having had the opportunity of studying closely many Bolivian mines, and, what is more, of being able to observe some of them over a term of years during development as they were passing through the critical stage of the transition zone. Unfortunately, because of the lack of research on the chemical aspect of the question, it is only possible to speculate as to what these prerequisite natural conditions are. It may be that the oxidation of associated pyrite has a reducing action on SnO_2, facilitating solution in the form of lower valence compounds; it may be that the presence of copper minerals brings about a transitional stannite alignment. In this connection it was noted that in the most pronounced cases of enrichment, copper was always present at a somewhat higher level, usually as chalcopyrite or as copper sulphate efflorescences. For the present I can only cite the geological evidence and leave its chemical corroboration or refutation subject to experimental work similar to that done in connection with secondary enrichment processes of other metals.

Mines Usually Shallow

As a rule Bolivian tin mines are not deep. Many of them have been worked only in the oxidized zone, the ores of which are often very rich. The grade of the sulphide ores, on the other hand, is usually considerably lower, especially in the lesser veins. As has already been pointed out, mere removal of the soluble associated minerals like pyrite, leaving residual cassiterite, is hardly enough to account for this enrichment of the oxidized zone, but successive re-solution and redeposition of tin, as the vein is being degraded by erosion, is a process that would bring within range all possible degrees of enrichment.

The primary sulphide zone marks the limit of the oxidizing and dissolvent action of surface waters. When this is reached the grade of the unenriched tin mineralization may not be high enough to warrant exploitation. In the minor veins the primary sulphide zone usually lies immediately underneath or close to the oxidized zone, but in the more important veins—namely, those formed on major fractures—there may be a belt of secondary sulphides between the oxidized and the primary zones, due to the greater circulation facilities of the major fractures. There is in the lesser veins a close parallelism between the surface outline of the vein and its primary zone. Many of them have only shallow outcrop workings. Others are worked by successive adits on the vein as it traces downward on the hill-slope, but such drift workings on the minor veins seldom remain in profitable ore after they get well underground and into the sulphides, even though the vein itself shows no signs of diminution. In short, the ore seems to be limited to a belt roughly concentric with the surface. This was such a common characteristic of Bolivian tin veins, before the development of Llallagua, that it was generally believed that these veins did not hold out attractive prospects for making deep mines.

Dependence of Ore Values Upon Topography Unlikely

It is, however, difficult to conceive of how such an apparent dependence of ore values upon the surface conformation can be due to primary mineralization factors. What possible relation can there be between the present topography and that existing at the time the veins were being filled? Miller and Singewald[4], after summing up the evidence, assign the age of these deposits to Pliocene. Although it is true that late Tertiary is relatively recent, geologically speaking, nevertheless the erosion that has taken place in Bolivia since that time is enormous, as is evidenced by valleys that have cut through cappings of rhyolite flows of this epoch, reaching 500 meters and more below them. This point is important, for it clearly indicates that the concentration of values near the present-day surface which indifferently cuts all horizons must be ascribed to factors other than those of primary differentiation.

There can be no question about the action of secondary processes. The only doubtful point is this: The extent to which enrichment may be attributed to leaching of soluble gangue constituents in the oxidized zone, rather than to solution and redeposition of cassiterite. I do not believe that the residual cassiterite explanation is in itself adequate except in very rare cases, and in this connection it should be interesting to note some of the phenomena occurring below the residual belt and below the zone of oxidation, in examples which deal with more important veins on major fractures and which are not so closely dependent on the surface conformation.

A Bonanza in the San Fermin Vein

At Llallagua some very good ore was found in the oxidized zone, but not nearly as rich nor as wide as in the sulphide zone a short distance below the oxidized and leached parts of the veins. Referring again to the San Fermin vein, which, as has been stated, is formed on an enormous dislocation, there is a shoot over 100 meters long, where the oxidized part of the vein was practically barren, its filling consisting of spongy, friable limonite and quartz. This material persisted over a vertical distance of about 80 meters. Lying immediately below it was a belt about 10 meters thick of

[4] "Mineral Deposits of South America," p. 100.

moderately rich cassiterite ore with associated marcasite and chalcanthite. This transitional belt was in turn succeeded by the real bonanza of the mine, where the vein showed 8-meter widths of 40 per cent to 50 per cent tin ore. The tin mineral was cassiterite and the principal associate, marcasite. Other associated minerals were quartz, pyrite, zinc-blende, greenockite, wolframite, and bismuthinite. The phenomenally rich zone extended downward about 30 meters and then began gradually to decrease in values. Marcasite gave place to pyrite and arsenopyrite. Greenockite and blende also occurred less abundantly. The vein itself became tighter. The rich ore with marcasite persisted to greater depths at one end of the shoot as a downward tongue where the vein had been cut off by a post-mineral fault accompanied by a wide and porous crushed zone. Tin values below the bonanza belt, although much lower, were more uniform, and such variations as were noted might well be due to primary factors. We thus have in the case of this vein, first, a low-grade to barren oxidized zone consisting mainly of limonite; second, a thin transition zone with copper sulphate efflorescences; third, a very sudden increase in the percentage of cassiterite, with marcasite as the principal associate; and, fourth, a gradual fading away of excessively high-grade tin ore to a more or less uniform primary grade, with parallel displacement of marcasite by pyrite and arsenopyrite. The other veins in the Llallagua district show a similar history, even though the facts seldom stand out as clearly as in the case of this particular shoot of the San Fermin; and it may be said, in passing, that it is often a question of luck to chance upon a geologic relationship in some particularly simple and lucid form, which will indicate the key in other instances where the relations are more complicated.

Presence of Marcasite Indicates Downward Leaching Solutions

The occurrence here of the mineral marcasite is especially interesting. This is generally accepted as a low-temperature mineral, a quite unlikely associate of primary cassiterite. But, waiving this point, its occurrence in the veins at Llallagua is in many ways suggestive of downward leaching solutions. It manifests itself in structures approaching stalactitic; in cellular honeycombed masses incrusted in places with pyrite apparently of the second generation; in plate-like layers alternating with blende and frankeite. Seeing it in place in the vein, it is difficult to escape the conclusion that it is a secondary mineral, formed by the alteration of its progenitor, the primary pyrite of the vein-filling. Another undoubtedly secondary mineral is greenockite, sulphide of cadmium, which occurs as a powdery coating on marcasite. However, the secondary character of marcasite and greenockite would not in itself be sufficient evidence to the effect that the associated cassiterite is also in part at least secondary. It merely indicates an unstable sulphide zone in which chemical interchanges are taking place, as distinguished from the untouched primary zone. It is conceivable, of course, that marcasite might replace pyrite *in situ*, leaving the primary cassiterite intact; that is, primary cassiterite mixed with secondary marcasite. However, it is difficult to reconcile the idea of unenriched primary cassiterite in the face of such evidence as that previously cited: barren oxidized zone; sudden enrichment in the marcasite sulphide zone; downward tongue of rich cassiterite and marcasite near the post-mineral fault zone where circulation of water would naturally be augmented; fading away in depth to lower grade but uniform ore with absence of marcasite and greenockite.

In the cited case of the San Fermin vein we also have the favorable circumstance of the vein itself having been formed on an enormous pre-mineral fault, with the consequent breaking up of the adjacent country, thus providing a good circulation medium, in connection with a low static water level, which permits of a continual downward flow within the saturated zone. This low static water level is due to the situation of Llallagua on the Atlantic side of the continental divide where the drainage to the sea is not interrupted, as in the case of the west-slope mines which have the inland basin of the Bolivian plateau forming a high-lying barrier to direct drainage to the sea; or, in other words, a high-lying stagnant zone not favorable to secondary reactions.

At Oruro Silver Is More Persistent Than Tin in Depth

In the important mines of Oruro, which is a silver-tin district, the high-grade silver and tin ores were found in the upper levels. With depth the grade of the ore in either metal becomes very much lower, but silver is more persistent than tin, and in some of the deepest workings the veins are being worked for silver alone, with tin still present, but of exceedingly low grade. According to our present conception of the zonal arrangement of primary mineralization, we would expect to find tin below silver and not the reverse. In this district the primary mineral filling apparently constitutes a silver ore with very low values in tin. By secondary working over (solution and redeposition), following degradation of the vein, the grade of the silver was brought to bonanza values and that of the tin to workable proportions. Going downward, with diminishing secondary influences, the grade of both metals decreases, until in the primary zone the ore is workable only as a silver ore. As this district drains to the high-lying inland basin, a very deep secondary zone is hardly to be expected.

At the Totoral mine the oxidized zone was marked by several wide parallel veins with good values in tin. These veins united on the dip to form one vein, which at comparatively shallow depths in the sulphide zone became narrow, with low tin values associated with pyrite and blende. The adjoining Antequera properties show a similar history of rich upper regions, becoming very low grade soon after the sulphides were reached. Farther west on the same mountain the Avicaya property has been worked to much deeper levels, but aside from probably being on stronger primary veins, the outcrops follow the surface downward, differing thus from the case of Totoral and Antequera, where the outcrop does not vary greatly in elevation along the strike. The deeper mine is on the veins where the outcrops reach lower levels—but, on present day, not Pliocene, topography.

Zinc Below Tin in El Salvador's Veins

Northwest of the foregoing group are the tin-silver veins of the El Salvador company. The veins outcrop from the low point of the river valley directly up the mountain slope, covering a vertical interval of about 500 meters. These veins were extensively worked by the Spaniards for silver, but good tin ore has also been found at depths generally not much over 50 meters from the surface. The topography lends itself admirably

to exploration by adits, and with these it was intended to open up vast tonnages of tin ore corresponding to expectations that the ores in the upper parts of the veins gave rise to. However, these adits soon proved that below the tin ore, and beyond the tin ore going horizontally into the hill, the mineralization changed to a rather good-grade zinc-blende ore, but with very low tin-silver values. That is, zinc below tin; another apparent contradiction of our ideas regarding zonal arrangement of primary mineralization. The tin-silver zone lies in the surface regions of the veins, whose outcrops cover a vertical range of 500 meters. This belt is, consequently, closely dependent on the topography; again, present-day topography and not Pliocene. It is simply a case of a primary zinc-blende vein with low silver and tin values. As the veins were being eroded the tin and silver minerals passed through many cycles of solution and deposition, until they finally built up the concentrated hoard found at the present day in the upper parts of the veins. The spectacular debâcle a year ago of the company owning these deposits might have been forestalled if these geologic factors had been duly appreciated.

Ore of Colorada Vein Undoubtedly Primary

However, not all Bolivian tin veins have undergone secondary enrichment. A good example of a typical primary vein that has not been enriched by secondary processes may be seen in the previously cited Colorada vein of the Oploca company at Chocaya. This vein has shown a remarkable constancy of grade over a vertical interval of a least 300 meters. The mineral filling is mostly pyrite and cassiterite, with minor amounts of quartz. These minerals occur as a series of repeatedly alternating bands lining the walls and enveloping breccia fragments with concentric rings. (See Figs. 1 and 2). The fragments are usually angular, of porphyry and of slate, very often commingled, and have no fixed orientation with respect to the walls. They are surrounded by sharply defined bands of cassiterite and pyrite and sometimes quartz, which are clearly deposited one layer on top of the other, from the fragment outward, and not from the outside inward, as one would naturally suppose if it were progressive replacement of a slab from the wall. Movement apparently took place also during deposition. Some of the fragments were broken and jostled about into new attitudes; layers of cassiterite and pyrite were again deposited on the new faces and across the broken earlier bands, forming what might be called textural "uncomformities." The walls at the north end of the vein are slate and at the south end porphyry, but fragments of either rock may be found next to walls of the other.

In the case of this vein it seems that some of the prerequisite natural conditions favorable to the solution of tin oxide are lacking, as the ore is undoubtedly primary. It may be due to some peculiar physical condition of the vein, or perhaps to the absence of minerals with contributory action in the solution of cassiterite. Bearing on this point it may be said that copper is rarely found in this vein. Marcasite has indeed been found, but as a lining in a subsequent reopening of the vein, and not directly associated with cassiterite. Secondary action has probably taken place, but the essential condition necessary to bring about solution of cassiterite was lacking.

The foregoing examples permit of a rough classification on economic lines something like the following:

1. Veins whose primary filling is too low-grade to be profitably worked, but which in the upper portions have been brought within the economic limit by secondary enrichment processes. Examples: the great majority of small displacement mines worked in Bolivia.

2. Veins whose primary filling is in itself exploitable with profit, but which have furthermore shown a secondary enrichment zone of exceptionally high values. Examples: Llallagua-Uncia, Potosi, Oruro.

Fig. 2—Hand specimen from Colorada vein, Chocaya
Isolated fragment showing small nucleus surrounded by alternate bands of cassiterite and pyrite. 1, Cassiterite with small amount of quartz. 2, Pyrite. Twice natural size

3. Veins whose primary filling alone is the basis of exploitation, and which have not been secondarily enriched. Example: Chocaya (Colorada tin vein).

The first class should be approached with caution. If the veins occur in sufficient number in any one district, they may constitute a perfectly sound mining venture. The warning is directed against the very common practice of basing an ambitious and costly program of development and exploitation in depth upon the showings of ore in the upper secondary zone.

On Primary Ores Hangs Future of Most Bolivian Bonanzas

The second class includes most of the bonanza mines of Bolivia. Their future prospects in depth must be based upon the grade of primary ores. New and unexpected favorable developments in these veins are not excluded, but they will be of relatively moderate proportions and will be due to primary factors, such as new oreshoots, vein intersections, change of country rock, and the like. Recurrences of the exceedingly rich secondary bonanzas at lower levels are not to be expected. However, such veins are usually major fault-veins, and as such they may offer very promising prospects along the lines of faulted extensions; recur-

rent swells after pinches in unfavorable rock; distant intersections with other veins; and under like conditions, more especially in such cases where these geologic contingencies might be expected to take place under capping rock or detritus, which would have concealed the showings from the sharp eyes of the native *cateador*.

The third class, veins whose primary filling is in itself rich enough for exploitation, is the type of deposits which presents the minimum amount of uncertainty for the future. The grade of the ore in any given shoot in such veins will fluctuate between much narrower limits than the secondarily enriched ores, and the vein may be expected to maintain its uniform grade to greater depths. These veins, furthermore, hold out the hope that perhaps somewhere in their unexplored extensions a new set of conditions might arise which would facilitate secondary reactions, such as intersections with other veins, bringing in a new set of minerals, with contributory action in the solution of cassiterite; or, post-mineral faults fracturing the vein and producing zones of freer circulation. If an already good-grade primary vein were secondarily enriched, the result would probably be a bonanza.

A Fourth Class of Deposit Possible

Consideration of the phenomena connected with the foregoing three classes of deposits cannot fail to suggest, as a very attractive possibility, an eventual fourth class. This class would comprise veins showing secondary characteristics at the outcrops, located in tin-bearing regions, with strikes and dips corresponding approximately to those of tin veins in neighboring districts, but which are either barren or show very low-grade tin and silver values at the outcrops. The attractive possibility resides in that the tin might have been more or less completely leached at the surface and redeposited in depth. Such veins, showing no outcrop values, would not have been prospected to the necessary depth, for it must be borne in mind that the secondary conception is new, and that all Bolivian mining heretofore has always been based on values showing at the surface itself. Veins that would fall into this class are numerous, and should it be proved that, in fact, some such action as outlined above has taken place, the facts developed would at once open up an enormous untouched reserve in Bolivia. Naturally, some geologic discernment would have to be used, as not all barren gossan outcrops in the tin belt imply secondarily enriched tin veins in depth.

Solution of Cassiterite and Redeposition at Depth a Natural Process

I could give other typical examples of secondary enrichment of Bolivian tin veins, but as the information was obtained in professional examinations I am not for the moment free to go into details. However, the examples already given cover a wide range of territory and include the most important mines of Bolivia; so it cannot be said of them that they are merely chance occurrences with no bearing on the generality of the process. The facts observed in the field have impelled me to the conclusion that solution of cassiterite in the veins and redeposition at lower levels, far from being a scientific curiosity of academic interest only, is a natural process of the most vital economic importance in Bolivia. It would indeed be interesting to hear from observers in other tin fields, especially Australia, South Africa, and the Malay Peninsula, where climatic, topographic, and mineralogic conditions are different. This paper was prompted by the hope that it might call forth some comments or bring out some evidence from these fields tending either to corroborate or negative the conclusions outlined above.

New Discoveries Likely with Aid of Geological Study

Bolivia is still a country with great possibilities for the discovery of new tin deposits, and in the present world-search for such deposits it is the region which probably presents the best prospects; but it must now be explored on scientific lines. The deposits that could be found by the Indian prospector have been found long ago. This simple stage is past. The problem in connection with many of these "surface value" deposits is to know when to stop, as much money has been and is being spent on hopeless prospects. The discovery of new tin orebodies must be guided in large part by geologic studies, for in this respect Bolivia still is a field practically virgin. Electrical prospecting based on such preliminary studies could probably be used to advantage in some cases, as many Bolivian veins, especially in southern Bolivia, carry a very high proportion of pyrite.

So far, the most serious geological work that has been done in that country has hinged upon the microscope. Detailed field studies have, however, rarely been made. Without underrating the value of the microscope as collateral evidence, I believe that large-scale relationships have a much more direct economic bearing. In uncharted Bolivia the theodolite is perhaps a more useful tool than the microscope, and the economic geologist will probably get more light from the surveyor and the physiographer than he would from the petrographer.

Explorations Continued in Northern Alaska

The topographic and geologic mapping of Naval Petroleum Reserve No. 4, in Alaska, that is being done by the U. S. Department of the Interior for the Navy Department, has involved three seasons of hard work by the U. S. Geological Survey. A further season's work is necessary. This is being done by a party composed of Dr. Philip S. Smith, the Survey's chief Alaskan geologist, and Gerald FitzGerald, topographic engineer, with two camp hands. A telegram from Doctor Smith states that he is proceeding to the town of Kotzebue, which lies on the Arctic Ocean, just north of the Arctic Circle. From here the party will proceed northwestward for 100 miles more, to the mouth of Kivalina River, where the work will start. The men will ultimately complete their work at the town of Wainwright, where they expect to obtain some sort of water transportation back to Nome, the northern terminus of the steamship route from Seattle. The party will probably not return to Seattle before Oct. 1.

New Aluminum Process Patented

The Czechoslovak Government has issued a patent to two local scientists, Otto Lederer and Dr. Walther Stanczak, of Prague, covering a new process for the extraction of aluminum from clay silicate and bauxite, according to the Department of Commerce. The method has been tested by the Ministry of National Defence, which has reported that aluminum free of iron and silicic acid can be produced from low-grade materials.

Features of the Magma Copper Smelter

Bin Arrangements and Methods of Feeding and Sampling—
Design of Special Equipment

By Leonard S. Austin
Mining and Metallurgical Engineer, Los Angeles

Leonard S. Austin

THE engineering details of the smelter of the Magma Copper Co., at Superior, Ariz., were described by H. A. Ruth in the Nov. 1, 1924, issue of *Engineering and Mining Journal-Press*. In a recent visit there, with the plant in operation, certain features impressed me as being worthy of further comment. To make reference clearer, the general plan of the smelter in Mr. Ruth's article may be consulted. Material is received in hopper-bottomed railroad cars, and consists of either company or custom ores, and fluxes. These are dumped in one of six concrete bins. Each of these is about 16 ft. square and has a pointed bottom converging to the discharge opening adjacent to the front vertical side. Ore is removed from the bin by a steel apron feeder which delivers on to a belt conveyor parallel to and immediately in front of the receiving bins. This leads to the crushing plant. If the ore hangs up in the bin, a louvered opening at the front permits access for poking. The track scales have been placed farther along on the track, and back of the crushing plant, thus leaving space for more receiving bins as the plant is expanded.

The separate concentrate bin is longer than the others. It is not in use, but is ready should an emergency require it. When used, the cars of concentrates are sampled by boring holes with a 2-in. sampling auger, in a diagonal line from corner to corner of the car. This sample is jarred from the auger into a box and sent to the sampling room, where it is cut down by hand methods. At the same time, a moisture sample is taken at about four places in the car, removing the top material to get at the wetter interior, better representative of average conditions.

This bin was placed in its advanced position so that its discharge could come upon the belt just opposite to the discharge from the Oliver filter plant. The conveying belt from it, No. 10, slopes downward to the hopper over No. 9 conveyor. The bin has a V-shaped bottom and a louvered opening with four louvers at the back permitting access to shake up the material when needed. As in the bedding bins, the bottom slit is covered by planking that is taken up as fast as the concentrates are discharged from the bin.

Three filter plant agitators are provided, each equipped with a mechanical agitator for the pulp entering by pipe line from the concentrator. To aid in this, compressed air from a compressor at the Oliver-filter house is admitted at the middle of the bottom of the tank. The agitator consists of a 2½-in. square shaft carrying the usual two stirring arms. The shaft and arms can be raised vertically above the pulp when the tank is not in agitation, thus avoiding their getting stalled when again starting. Fig. 1 is a sketch of a proposed apparatus for feeding milk of lime to the concentrate pulp before filtering, the object being to coagulate the slime and give a dryer and thicker cake on the filter.

A sample cut is made across conveying belt No. 11 that comes away from the Oliver filters. This is done by hand every fifteen minutes. The cut is made with a hoe with a blade 2 in. wide, square across the belt, the material dropping into a box below.

There are four bedding bins, each about 25 ft. by 100 ft. inside dimensions, and each partitioned 15 ft. from the front end for the storage of dry, crushed material. Each bedding bin has a V-shaped bottom and

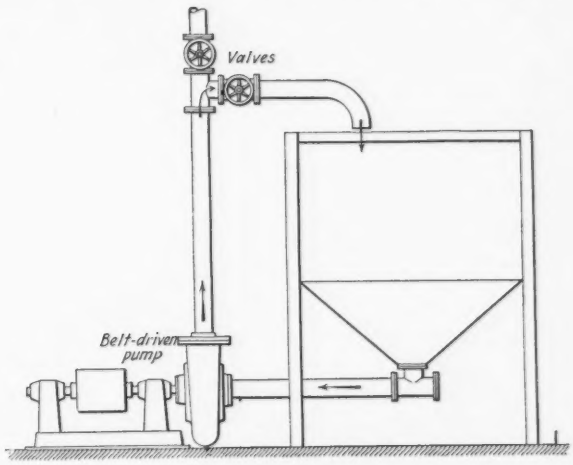


Fig. 1—Method of pump agitation of concentrate pulp

perpendicular ends, louvered at the back end. The bottom drawing-off slit, 3 ft. wide, is covered by transverse planks, which are taken up successively when discharging the bin. A man is then kept constantly in the bin to loosen and run the ore down to the long conveying belt below, this in turn delivering upon conveyor No. 9. When a bedding bin is to be filled, the tripper, set centrally at the end of the bin, delivers ore from conveyor No. 5 onto the feed belt of the bin. Commonly, the tripper of this belt would shoot the ore directly into the bin, but as the concentrates carry 12 to 14 per cent moisture, and so are sticky, the material would hang up. To avoid this, a short cross-belt, with pulleys at 8-ft. centers, delivers a stream of ore falling 5 ft. from the center line of the bin. Scrapers, just below the delivery point, assure that the concentrates leave the belt. It is to be understood that the final tripper travels from end to end of a bedding bin auto-

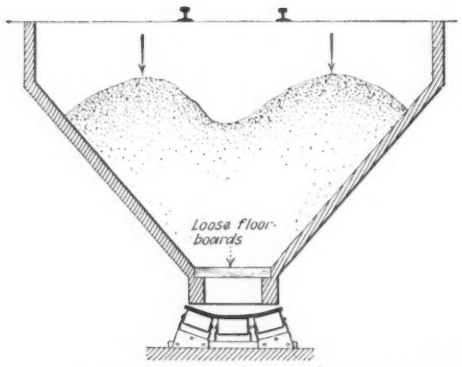


Fig. 2—Transverse section of bedding bin

matically. When it has made its return trip, the short cross-belt at the end reverses so that delivery is at the other side of the central tripper track. Fig. 2, a sketch of the cross-section of the bin, shows how the ore distributes itself in layers. The outer portion is rather coarser than directly under the discharge.

The dry material, such as limestone and flux, is delivered into the short end bins with one setting of the tripper. When filled, the contents of the bin is withdrawn at the back (the division wall) upon delivery belt No. 5, or at the front end to a car set at the front opening. Delivery to cars is through a chute gate, but with no feeder.

Of the five roasters installed, four are in use, since the reverberatory is operated at present to smelt only 400 tons daily, though it has an estimated capacity of 600 tons. To produce a matte of 40 per cent copper, considered the most satisfactory for converting, no decided elimination of sulphur is needed, so the charge is roasted only to about 12 per cent sulphur. The upper two hearths are bypassed, roasting beginning only on the third hearth. The calcine car has three top openings, the two end ones for the calcine and the central one for the return of the escaping air into the flue. Still, a little dust is made. The discharge from car to furnace is less successful, quite a cloud of dust being inevitably made.

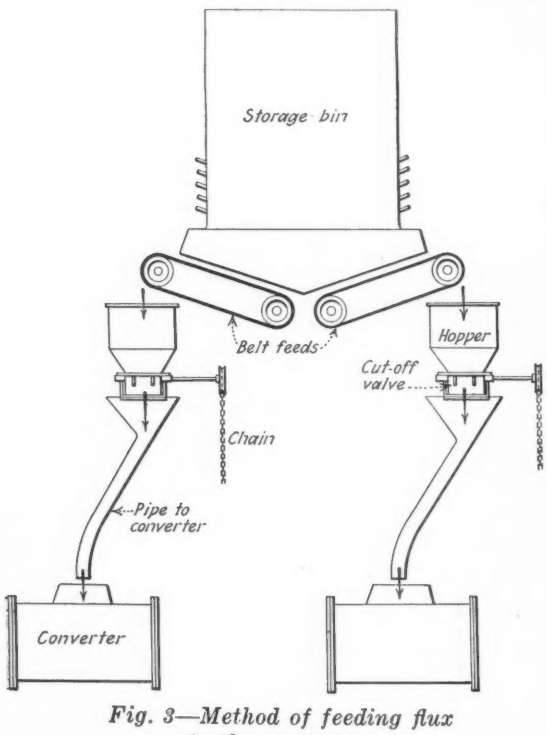


Fig. 3—Method of feeding flux to the converters

Flux is brought to the converters by a hopper-bottom car at the charge-floor level, where it is discharged to the boot of a vertical bucket elevator. This raises it to the storage hoppers above the converters, from which it is withdrawn over a conveying belt into suspended hoppers to the right and left as shown in Fig. 3, supplying either converter.

The casting machine is of the Cerro de Pasco type, pouring being done by a special arrangement as follows: The ladle containing the molten copper is set on a stand. A cradle then picks it up by the trunnions, the ladle being gradually raised and tipped to discharge the copper to a pouring spoon. The ladle pours continuously, the spoon intermittently. When a mold is filled, the lip of the spoon is raised to stop the flow until the next mold of the endless casting machine is in position. In the older way, when the copper was directly poured from the ladle, all depended on the skill of the crane man, and much irregular molding was done. At present, the operator is stationed in a near-by cab where he can direct every movement, and the ingots are neatly poured. The casting machine proper is of Allis-Chalmers make. The ingots have the usual blistered top, and must be trimmed before weighing and shipping.

Large Bauxite Reserves Reported in Jugoslavia

Bauxite, the principal ore of aluminum, is produced in Dalmatia, Jugoslavia, near the Adriatic Coast, according to a correspondent of the *Mining Journal*, London. During the war, about a quarter of a million tons was exported from this district to the Central Empires. Since then great interest has been taken in prospecting and preliminary work, and one company, the Adria Bauxite Co., is progressively increasing its output, which in the latter part of 1924 and in 1925 amounted to 86,000 tons and is expected to exceed 150,000 tons in 1926. Other companies are working in Jugoslavia which are not producing at present, with the exception of the Jadranski Bauxite Co., in Spalato, which is controlled by the Aluminum Company of America and which exported 4,000 tons to Norfolk in 1925. It is expected that the other companies will reach the production stage in the near future.

The Adria Bauxite Co. exports to America and to Rotterdam (Neuhausen), and as its bauxite becomes better known will probably export to other consuming centers. Mining of the deeper deposits has been started, and incline shafts are being driven, one of which is now 90 meters deep on a slope of 45 deg.

The reserves of bauxite of the Adria Bauxite Co. are large, and, together with those of the other companies, constitute one of the world's most important sources of supply and reserves for the future. Shipments made to date have averaged 55 per cent Al_2O_3, 20 per cent Fe_2O_3, and 20 per cent water, with 2 per cent of titanium oxide and silica. The Adria Bauxite Co. is now exporting a very high-grade ore, which gives an average analysis of 63 per cent of alumina with less than 1 per cent of silica, the low silica content being the Dalmatian specialty.

Discovery and Depletion Provisions of the 1926 Revenue Act

Flat Rate of 27½ Per Cent Substituted for Former Oil and Gas Well Deduction—Allowance for Mines Broadened

By A. Werner Lawson

Valuation Engineer: Associate of Wilson and Wagner, Washington, D. C.

A. Werner Lawson

THE Revenue Act of 1926, under the provisions of which the taxable net income of taxpayers in the United States for 1925 and later years will be determined, was enacted into law on Feb. 26, 1926. The majority of the revisions of the Revenue Act of 1924 drafted into the new law relate to the rates of taxation and the simplification and clarification of the administrative provisions. Two new provisions not directly included in any of the prior acts are incorporated in the new act. These have to do with the question of "discoveries" to mining companies, and the basis for the determination of depletion to oil companies—both of which are questions of paramount interest to the respective industries.

The basic provisions relating to depletion allowance from gross income, to both individuals and corporations, subsequent to March 1, 1913, were first enacted in the Revenue Act of 1918. These provisions with certain minor modifications relating to the limitation of the amount of depletion which could be deducted were carried forward into the Revenue Act of 1921. With still further modifications, limiting the deduction and the broadening of the scope of the discovery clause, they were re-enacted in the Revenue Law of 1924. The basic provisions prescribing the right of the taxpayer to deduct from gross income a reasonable allowance for depletion of mining and oil deposits discovered after March 1, 1913, as well as the basis for such allowances, are contained in sections 214 and 234 of the acts of 1918 and 1921 for individuals and corporations respectively. In the act of 1924, the basic provision relating to the right of depletion allowance is contained in the same numbered sections, but the basis for allowance of discovery depletion is contained in Section 204.

In each of the foregoing acts the right is given to deduct from gross income "a reasonable allowance" for depletion of mining or oil and gas deposits discovered subsequent to March 1, 1913, provided such deposits were ". . . not acquired as the result of purchase of a proven tract or lease. . . ." Furthermore, in each case it is provided that "such reasonable allowance in all cases to be made under rule and regulations to be prescribed by the Commissioner with the approval of the Secretary." In no one of the prior acts, wherein depletion deductions on account of discovery have been provided for, has Congress attempted to define a "discovery" or "a reasonable allowance" in either the case of a mining or an oil and gas deposit. Neither has it legislated in any way as to the limitations of such. This question has been left entirely to the Commissioner, who, with the approval of the Secretary, has prescribed rules and regulations under each of the respective acts to govern the definition of a discovery and the determination of a reasonable allowance. The questions of when a discovery had been made, the extent of the discovery, limitations of further discoveries, and similar questions relative to the discovery valuations, which have been used as a basis for the reasonable depletion allowances, have been decided by the Commissioner, with the widest possible latitude.

Complications in the Application of the Law

Though the same language in the provisions of the various revenue acts applied to both mining and oil and gas deposits, the vast differences inherent in the character and occurrenees of the two types made it necessary to treat them separately and upon an entirely different basis in the regulations relating to their valuation. As compared with the March 1, 1913, basic date, the valuation of oil and gas discoveries as of subsequent basic dates, and the promulgation of equitable and reasonable regulations relating to the latter, became extremely difficult. With regard to the former, certain more or less fixed factors as well as estimates of reserves, in most cases based upon more or less settled production, could be determined. With regard, however, to discoveries, each one as of a different basic date, within thirty days of discovery of oil in commercial quantities, under highly fluctuating market conditions as to prices of oil, indeterminate conditions as to reserves, and the practically indeterminate definition of what constituted a proven tract or lease, an equitable and reasonable interpretation of the discovery provision became a stupendous and exceedingly difficult undertaking. Of necessity it resolved itself largely into a question of adopting certain arbitrary factors in the control of the valuations. In the case of mineral deposits, where developments are very much slower and discoveries fewer in number than in the case of oil, the task was much less difficult.

Oil and Gas Discovery Abolished

Increasingly frequent criticism of the lack of definition in the provisions of the law relating to discovery finally convinced Congress that the provisions relating thereto should be removed if possible from the sphere of interpretation by the Treasury Department. The result has been that in the Revenue Act of 1926 oil and gas discoveries have been abolished. Furthermore, all valuations of oil and gas companies as of any basic date as a basis for determining depletion deductions from gross income have been abolished. For this there has been substituted a flat deduction equal to 27½ per cent of the gross income, but not to exceed 50 per cent of the net income (computed without the allowance for depletion), nor to be less than if depleted on cost.

In the case of mining companies valuations as here-

tofore made will be continued, but the definition of a "discovery" has, for the first time, been incorporated in the discovery clause. These two provisions are found in Section 204 (c) paragraphs (1) and (2) relating to the "basis for determining gain or loss, depletion and depreciation," and read as follows:

Section 204, (c). (1) "In the case of mines discovered by the taxpayer after February 28, 1913, the basis for depletion shall be the fair market value of the property at the date of discovery or within thirty days thereafter, if such mines were not acquired as the result of purchase of a proven tract or lease, and if the fair market value of the property is materially disproportionate to the cost. The depletion allowance based on discovery value provided in this paragraph shall not exceed 50 per centum of the net income of the taxpayer (computed without allowance for depletion) from the property upon which the discovery was made except that in no case shall the depletion allowance be less than it would be if computed without reference to discovery value. Discoveries shall include minerals in commercial quantities contained within a vein or deposit discovered in an existing mine or mining tract by the taxpayer after February 28, 1913, if the vein or deposit thus discovered was not merely the uninterrupted extension of a continuing commercial vein or deposit already known to exist, and if the discovered minerals are of sufficient value and quantity that they could be separately mined and marketed at a profit.

(2) "In the case of oil and gas wells the allowance for depletion shall be 27½ per centum of the gross income from the property during the taxable year. Such allowance shall not exceed 50 per centum of the net income of the taxpayer (computed without allowance for depletion) from the property, except that in no case shall the depletion allowance be less than it would be if computed without reference to this paragraph."

Depletion of Mines

The basis for the depletion for mining companies under the new revenue act is identical with that under the provisions of the 1924 act save for the addition to Section 204 (c), paragraph (1) of the clause which defines a "discovery." This provision, while having relieved the Commissioner of the responsibility necessary under the prior acts of defining a discovery, is as a matter of fact in part a validation of a portion of Article 220, Regulations 65, which embodied the definitions and regulations relating to discoveries of mines under the 1924 act. Under a fair and reasonable interpretation of its wording, the new provision should give a scope to discoveries, so far at least as regards their distribution, that should answer practically all the requirements of the mining industry.

It is perhaps unfortunate that Congress did not make the discovery clause more comprehensive, explicit, and complete in its provisions. This would remove the question of discoveries, in great part, from the necessity of interpretation regarding its scope and definition by the Treasury Department. It could readily have embodied the better and eliminated the less desirable features of the regulations heretofore applicable as they have been gradually developed, broadened, and modified in accordance with experience of the Treasury Department during the last few years. This failure is the more regrettable in view of the fact that the application of the provision is of such importance to the mining industry.

The language of the discovery clause provides in effect that discoveries shall include mineralized deposits or oreshoots of commercial quantity and grade discovered by the taxpayer after March 1, 1913, whether in property owned by the taxpayer at that date or acquired subsequent thereto, provided that the acquisition subsequent to March 1, 1913, was not a "proven tract or lease" and provided, further, that the fair market value of the deposit or oreshoot discovered and developed to commercial proportions was, within thirty days after such development, materially disproportionate to the cost of the property, and provided, further, that the orebody ". . . thus discovered was not merely the uninterrupted extension of a continuing commercial vein or deposit already known to exist. . . ."

Congress, while specific in its definition of what a discovery shall include, has entirely neglected to define a "proven tract or lease." This may seem to be of slight importance, in view of the authority vested in the Commissioner to make such a definition. In my opinion, it has given rise to an anomalous situation. The definition of a "proven tract or lease" as provided in Article 219 of Regulations 45 and 62 and Article 220 of Regulations 65 prescribes that ". . . a 'proven tract or lease' includes, but is not necessarily limited to, the mineral deposits known to exist in any known mine at the date as of which such mine was valued for the purpose of depletion, and all extensions thereof, including 'probable' and 'prospective' ores considered as a factor in the determination of the value or cost. . . ." In other words, no mineralized deposit, which may have been discovered or developed in a known mine, that was of too low grade to be considered commercial ore, but which by reason of favorable changes in economic conditions or the metal market became commercial, could be claimed as a discovery to a taxpayer who subsequently acquired the property. However, if a taxpayer owning the property either at March 1, 1913, or, having acquired it subsequent thereto, discovered or developed such a low-grade deposit, which later, by reason of economic changes or favorable metal prices, assumed commercial aspects, it would appear that the language of the discovery clause would permit a discovery valuation of such a deposit, *provided* that it was *not* "the uninterrupted extension of a continuing commercial vein or deposit already known to exist." That is to say, if it were on another vein from that on which commercial deposits were known to exist, or even on the same vein but separated from known commercial deposits by barren, non-commercial vein matter, the taxpayer would be entitled to a discovery. If, on the other hand, the deposit which may have been developed was a portion of an extensive continuing uninterrupted mineralization, portions of which were commercial and other contiguous portions as lateral or vertical extensions were non-commercial at some prior date, but became commercial through economic conditions, then such contiguous portions could not be claimed as discoveries. Such conditions are not infrequently the case in the extensive orebodies of the iron regions and in the case of copper porphyries, and similar cases might be multiplied in the lode mines of the Western mining districts. It would appear, if this view is correct, that an inequitable and anomalous situation has been created, for there is from a practical standpoint very little, if any, difference to the taxpaying mine owner whether this ore which becomes commercial in grade and quantity happens to be simply co-extensive with an already known commercial orebody or is separated from it, as on another vein or by non-commercial barren ground on the same vein.

In any event the new provision appears to give ample latitude to the mining companies in all new discoveries

of unknown oreshoots, whether occurring in hitherto known or unknown veins, or elsewhere. Some discretion is apparently to be allowed the Treasury Department in the matter of how the wording "uninterrupted extension of a continuing commercial vein or deposit" may be interpreted. It is frequently difficult if not impossible to determine whether or not commercial mineralization as of any basic date is uninterrupted in its continuity until the mine has been exhausted. Whether or not continuity between bodies of commercial ore at a few scattered points is to be construed as barring taxpayers from discoveries of orebodies otherwise in all respects essentially separate and distinct remains to be seen.

The final sentence of the discovery provision in the new act is apparently intended to validate the regulation in force under the 1924 act relative to the limitation of the value of a discovery to that which it would have to a "prospective purchaser who would require mine openings, plant and equipment, and other facilities independent of those utilized in working other mines in the vicinity, and who would exhaust the new mine at a rate commensurate with such independent facilities." The department has always argued that this provision becomes necessary by virtue of the limitation of the value to that "of the fair market value of the property at the date of discovery." However, in the case of a bona fide purchase, which requires the actual construction of the necessary plant and equipment, the purchaser would under the provisions of the law have returned to him tax free the amount of such capital investment in the form of depreciation. In the case of a discovery to a going concern whose plant and equipment is already ample in most cases, if not all, to meet the requirements of production and marketing of the discovered ores, the estimated cost of the theoretical plant and equipment is a direct deduction from the depletable values of the ores, just as though it had been spent, but no return or deduction from income in the form of depreciation is provided for. Certainly, in cases where the expenditure for plant and equipment is not necessary, or if only a certain amount of improvements or additions to existing equipment are necessary, consideration of that fact should, it seems, be taken and deductions only made in accordance therewith.

It is at least hoped that, in connection with the promulgation of the new regulations, serious contemplation will be given to the equities involved in this consideration and that a fair and reasonable interpretation of its execution, as well as one less drastic than that contemplated and effectuated in the past regulations, may result.

If, as it seems, it was the intention of Congress to correct the alleged inequalities in depletion allowances to oil companies arising from the uncertainties and difficulties inherent in the determinations of valuations as a basis for such allowances, it has succeeded admirably in doing so. Despite, however, the abolition of discovery and March 1, 1913, valuations for depletion purposes, Congress has not succeeded, and probably never will be able to, in divorcing the Commissioner entirely from the necessity or responsibility of making comprehensive and difficult valuations and the promulgation of regulations governing such. There still remains the necessity for the determination of "fair market value" as the basis for the computation of the amount of gain or loss or cost in certain forms of transfers of oil and gas properties. Also, in certain cases, a "determination of the reserves," or the "fair market value" at acquisition, as a basis for depleting the cost, may be necessary when it appears that the percentage of gross income allowable as depletion is less than depletion on cost. However, such valuations as are necessary will be relatively few as compared with those required under the prior oil and gas discovery depletion provisions.

Every individual or oil company, regardless of how or when the property was acquired, whether by gift, acquisition for stock or cash, prior to or subsequent to March 1, 1913, is, it would seem, entitled to 27½ per cent of the gross income as a depletion allowance. All prior valuations relating to the amounts to be depleted are, apparently, revoked. The question as to whether or not the rate of 27½ per cent provided for in Section 204 is, in accordance with the provisions of Section 214, "a reasonable allowance for depletion," remains to be determined. This is a compromise rate between the 25 per cent proposed by the House of Representatives and the 30 per cent rate proposed by the Senate, and is, in the opinion of Congress, a "reasonable allowance." Doubtless, this rate will affect many oil companies adversely, especially those which have been taking depletion based on discovery valuations made during the peak of high prices, with correspondingly high depletion rates. On the other hand, it should react favorably to such as were unfortunate enough under the old régime to make their technical discoveries on the low points of the price curves.

THE BASIC PRINCIPLE relating to the allowance of depletion to industries deriving their existence from wasting assets has been recognized to the fullest degree. All oil companies, so far as the basis for depleting their assets is concerned, have been placed upon absolute parity, each being entitled to a flat rate of 27½ per cent of gross income but not to exceed 50 per cent of the net income, or an allowance on cost if in excess of the above rate. With reference to mines, the new provision appears to give ample latitude in all new discoveries of unknown oreshoots, whether occurring in hitherto known or unknown veins, or elsewhere. Whether or not continuity between commercial orebodies at a few scattered points is to be construed as barring taxpayers from discoveries of orebodies otherwise in all respects essentially separate and distinct remains to be seen when new regulations governing the matter are written.

The provisions would have been more complete had Congress defined the terms "gross income" and "net income" from the property. These are terms which are still subject to interpretation by the Treasury Department and will be the basis of difference of opinion between the taxpayer and the department as has been the case in years past.

The oil and gas depletion provision contains the saving element that ". . . except that in no case shall the depletion allowance be less than it would be if computed without reference to this paragraph." This clause means that in no case shall the depletion allowance granted at the 27½ per cent rate, with the 50 per cent limitation, be less than the depletion which would be allowed if the property was depleted on cost. In certain cases where the oil and gas wells are acquired for cash, or where they are acquired for stock, or for cash and stock combined, where the stock has no definitely fixed marked value, there may arise the necessity for making a determination either of the reserves acquired as a basis for depletion on cost where cash is involved, or of the "fair market value" of the property where stock is involved. However, such valuations will be relatively few, and very little, if any, change in the general regulations at present controlling them is anticipated.

The simplification of the procedure with regard to depletion determinations for oil producers is, of course, equally applicable to operating fee owners, lessee operators, and lessors, for each is entitled to his deduction of 27½ per cent of the gross income from the property, within the limitations and exceptions provided in the law. It is obvious that this provision is a great relief to a multitude of small lessors who in many cases under the old provisions and regulations were dependent upon their respective lessees for information relative to the valuation of their equities in the leases and a proper determination of their equitable apportionment of the allowable depletion deduction. It would appear from the language of the provision that no apportionment by the commissioner, as between lessor and lessee, other than that specifically provided for in the depletion clause, will be permissible. Consequently, in the case of lessors whose entire royalties are both gross and net income their depletion will be simply 27½ per cent of such royalties.

Revival of Gold Dredging in New Zealand

By Peter G. Tait
Special Correspondent

BECAUSE of the prospects of a revival of gold dredging in New Zealand I visited Otago Central recently. No accurate records are available of the total gold won by dredges and small parties of miners from the Clutha and Kawarau rivers, but it is known that much gold was recovered. At the height of the dredging boom in 1906, there were 167 plants at work. The last of these was sunk in 1924, when dredging operations ceased. The record week's return was obtained by the Lady Ranfurly dredge in 1904, with an output of 1,273 oz.

One of the boldest schemes suggested is the proposal to dam the Kawarau River, which is the outlet of Lake Wakatipu—a snow-fed sheet of water more than 50 miles in length and about 1,200 ft. above sea level. Its present bed is 50 ft. or so below the original bed, and the high level beaches or terraces so formed were systematically turned over by the early miners. They, however, were unable to get into the present bed by reason of the depth and fast-flowing current. Though a number of the dredges obtained good returns, it is maintained that it was only in favorable parts that these small old-time dredges were able to work the bottom. The idea of the promoters of the Kawarau company was that if they could hold up the river even for a few months during the winter, when the flow is at a minimum, it would enable operators to recover the gold which it is believed lies there in huge quantities. They therefore obtained a lease of 32 miles of the river and had no difficulty in selling claims one-quarter of a mile in length for £1,000 each and a royalty of 20 per cent of the gold won. The monetary proceeds are being applied to the construction of the dam at the outlet of the lake, and this structure is well in hand, although it is unlikely to be completed for another six months. At its best, however, the dam will not lay bare the river bed, as several rivers of considerable flow, Shotover, Arrow, Nevis, and innumerable small mountain torrents, flow into the Kawarau.

As already stated, the Shotover River flows into the Kawarau. Owing to the impossibility of access in the days of the dredging boom, only one small dredge was installed, but it worked a very limited area. As in the case of the Kawarau, the terraces have been thoroughly prospected and worked. The Shotover gorge is very rugged, but the country differs from the Kawarau in that there are fewer large boulders, and the rock is a soft micaceous schist. The Shotover Gold Dredging Co. was floated in Melbourne several years ago, and an order was placed for a Thompson suction cutter dredge with a 16-in. gravel pump. The erection of this plant is approaching completion and will soon demonstrate its ability to work the river bed. It is electrically operated and has a capacity of 100,000 cu.yd. per month. Included in the equipment and fitted into the barge is a diving bell with which it is proposed to clean up the crevices in the river bed where concentrations of gold are expected to be found. The assumption that gold exists in the bed is justified from a study of the facts and by dish prospects. Whether it exists to the fabulous extent claimed by the optimistic promoters, or even in payable quantities, remains to be proved. The next few months will tell. The government appears to be somewhat concerned at the trend of events and is holding its hand in regard to the issue of further leases.

Another dredging enterprise of interest is located at Hotikita, on the West coast, the south island of New Zealand. Some years ago an Australian company took up the Rimu Flat and installed a small bucket dredging plant such as had been used in the Otago district. It proved unsuitable and the area was subsequently taken over by an American company, the Rimu Gold Dredging Co., which has erected an electrically operated Californian type dredge of a much more powerful type than any hitherto operating in New Zealand. This dredge, since September, 1921, has handled an average of 1,365,000 cu.yd. annually.

Useful Operating Ideas

Underground Ore-Bin Construction at the United Verde

By C. E. Mills
Chief Engineer, United Verde Copper Co., Jerome, Ariz.

At the United Verde mine, Jerome, Ariz., ore from below the Hopewell tunnel, which is at the 1,000-ft. level, is delivered by skips to two bins which discharge through gates into standard-gage cars hauled by electric locomotive on the tunnel level. Loading chutes and bin construction are shown in Fig. 1. The front support of the bin is formed by six vertical 24-in. I-beams which rest on a concrete wall and are braced by 12-in. I-beams near the top and 15-in. I-beams at the bottom, and the front wall of the bin is formed by horizontal H-beams bearing against the vertical I-beams and supporting steel plates. The bottom of the bin consists of 1-in. plates supported by 12-in. I-beams, inclined at an angle of 45 deg. There are five chute gates to each bin. The

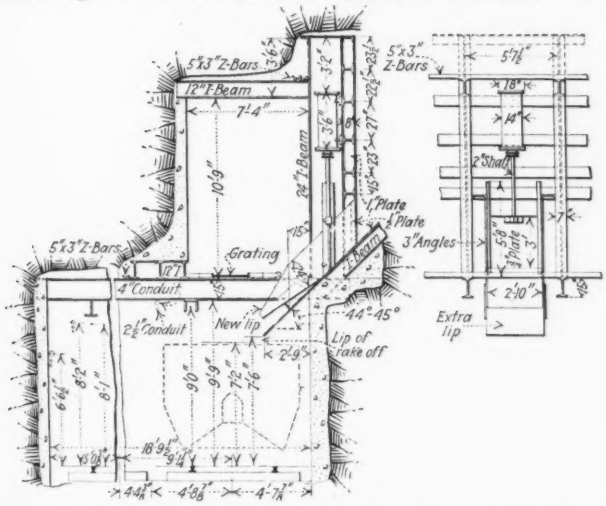


Fig. 1—Original chute and loading-bin construction

vertical I-beams are at 5 ft. 7½-in. centers. Gate opening is 2 ft. 10 in. wide and the gate of ¾-in. plate is 3 ft. high. The gate slides in grooves formed by a pair of angles. It is operated by a 14-in. O.D. air cylinder. The clear opening of the gate is 2 ft. high. This chute and gate have proved satisfactory for mine ore, which must first pass a grizzly, the openings of which are 12 by 15 in.

An improved chute and gate construction was designed for the transfers delivering ore from the open pit. All ore is delivered over grizzlies on the 900 level, the bar spacing of which is 15 in. Ore is received in a vertical transfer (8 by 15 ft. in cross-section) which terminates in an incline leading to a pair of gates and chutes. The gate opening is 5 ft. wide and 2 ft. 3 in. high. The smaller gate opening used in the shaft ore bins proved to be too small for steam-shovel ore, which is occasionally wet and sticky and contains more or less old timber. A standard bin for all loading bins on the

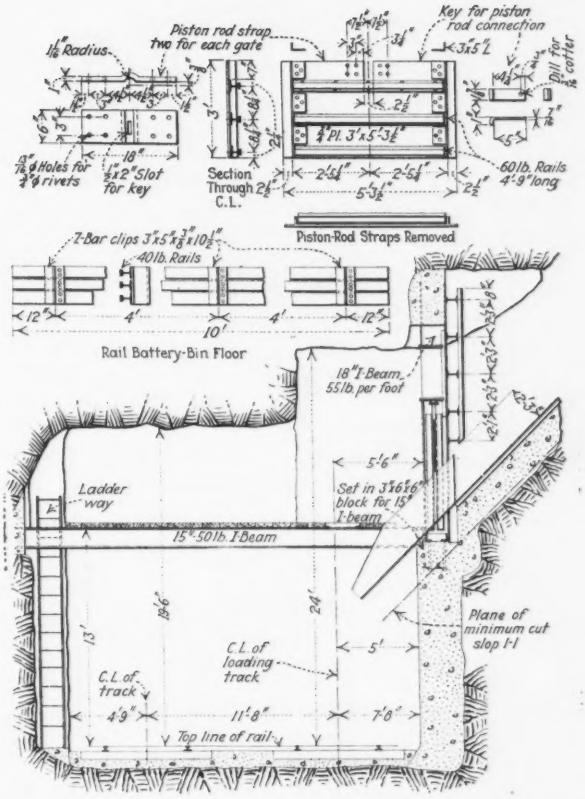


Fig. 2—Improved chute and loading-bin construction

1,000 level is shown in Fig. 2. It is simpler in construction than that shown in Fig. 1. As will be noted, the bin front is formed by three vertical 18-in. I-beams which are anchored at the bottom to a concrete wall forming one side of the tunnel and concreted in a hitch at the top. Three 15-in. I-beams are used to brace the lower ends of the vertical I-beams; and the ends of these beams are placed in hitches and concreted in place. The front wall of the bin is formed of vertical rails supported by 8-in. I-beams. The sloping floor of the bin is

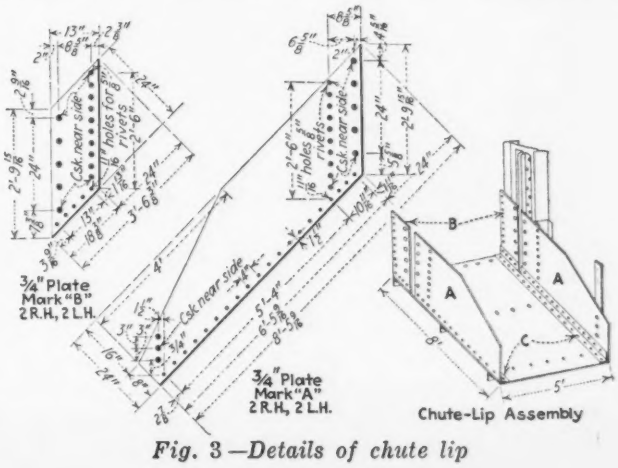


Fig. 3—Details of chute lip

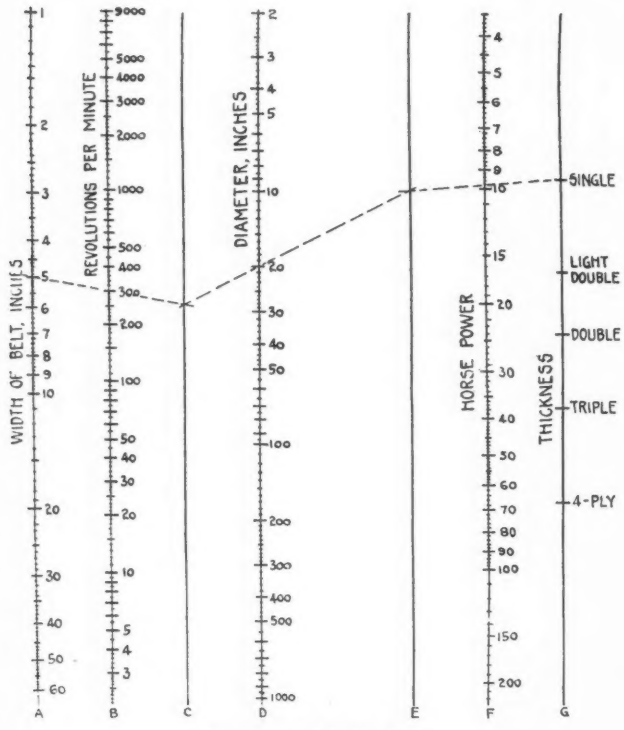
constructed of 40-lb. rails 10 ft. in length. These rails are riveted in groups of three to Z-bar clips and are concreted in place. Guides for the gates are angles 3 by 5 in. by ⅜ in., 6 ft. 4 in. in length. Gates are constructed of ¾-in. plate stiffened by three lengths of 60-lb. rail. Details of the chute are given in Fig. 3. An operating platform is supported by the horizontal I-beam braces and access is provided by an arched crosscut and offset ladderway as shown in Fig. 2.

The design shown in Fig. 2 has proved to be sufficiently rugged for the service, and few repairs have been necessary since the first installation in 1924. Loading time for a 10-car train of 30 tons per car averages 5 minutes, which represents 8 per cent of the total time per trip on a 1.5-mile run to the transfer bins at the portal of the Hopewell tunnel.

Power and Belt Chart

By W. F. Schaphorst
Newark, N. J.

A chart that quickly tells nearly everything that one might want to know about a belt drive is shown in the accompanying figure. Simply zigzag across as indicated by the dotted lines and get whatever estimate is required. The figure indicates all widths of belts varying from 1 to 60 in., all revolutions per minute varying from 3 to 9,000 r.p.m., and pulley diameters from 2 to 1,000 in. It also gives the horsepower to be expected from single, light-double, double, triple, and four-ply belts.



Power and belt chart

To use the chart, find the width of the belt in inches in Column A and then run a straight line through that width and the pulley revolutions per minute in Column B and locate the intersection in Column C. Then from that point of intersection run through the diameter of the pulley in inches in Column D and locate the intersection in Column E. Then from that point of intersection run over to the thickness of the belt in Column G, and the intersection in Column F gives the horsepower. If, after reaching Column E, the horsepower is known and it is not certain whether the belt should be a single, light-double, double, triple, or four-ply, run a straight line through the intersection in Column E, and the horsepower in Column F and the intersection of Column G will give the number of plies or thickness of the belt.

Regarding Column G, these spaces are based upon figures given by the late Frederick W. Taylor. Thus, a light-double belt will transmit about 33⅓ per cent more than a single belt. A double belt will transmit about 50 per cent more than a single belt; a triple belt will transmit about twice as much, and a four-ply belt will transmit about two and one-half times as much.

If the thickness of the belt, horsepower, diameter, and revolutions are known, and it is desired to determine the width of the belt, begin at the right and zigzag over toward the left, and the width is found in Column A. Thus, if four of the factors are known, the fifth is easily determined by simply running straight lines across the chart as indicated by the dotted lines in the figure. For example, the figure shows that, if the width of the belt is 5 in., the pulley makes 300 r.p.m. and is 20 in. in diameter, and if the belt is a single belt, it will then transmit 9.8 hp.

Pit Scraper for Loading Iron Ore

By L. C. Moore
Hibbing, Minn.

At the beginning of last year's ore season a Sauerman scraper was installed in the Miller open-pit mine at Aurora, Minn., to replace a steam shovel, cars, and locomotive formerly used for loading ore. This was the first pit scraper installation on the Mesabi range, and after testing for the season by loading out 200,000 tons, it was pronounced a complete success and a money saver. A 75 hp. two-drum electric hoist and a 1½ yd. scraper is used. As the ore is hard it was drilled and blasted, this work leaving some large chunks which the scraper could not more readily. To correct this trouble a Model 36 Marion shovel mounted on caterpillars was used to cast the ore in front of the scraper and set the chunks to one side to be broken. This procedure secured the desired monthly output and reduced the number of men employed from thirty-two the year before to twenty-four.

In this installation the scraper moved the ore radially to a central raise, the longest pull being 400 ft. A heavy grizzly was installed over the raise. A guyed mast was first tried at the grizzly to guide the scraper, but the strain was found too great and after the second break it was replaced with a heavy-timber A-frame. To move the tail block around the edge of the pit a heavy cable was anchored to deadheads on each side and the head-block was attached to this cable and moved along by means of a winch.

The daily loading was carried on two shifts, three men on the shipping pocket and nine in the pit. This number included steam-shovel operator and fireman, scraper hoist man, grizzly man, blaster and helper, pit foreman, and laborers. The largest tonnage secured in one month was 49,000 in July. The Miller mine belongs to the Pitt Iron Mining Co.

Discussion

The Proper Place for Refining Copper

THE EDITOR:

Sir—I have been reading with much interest your article on the movement to establish a new copper refinery at Los Angeles, which was published in the number of *Engineering and Mining Journal-Press* received here Feb. 20. In my opinion, however, such copper producers of the Western states wishing to escape the monopoly of the powerful Eastern refineries would have many more chances of success by following the suggestions made by your editor T. A. Rickard in the first chapter of his "Journey to South Africa" (June 6, 1925).

In discussing the matter with his fellow passengers on the steamship "France" he came to the conclusion that the proper place for a refinery would be France. Germany has a good refinery at Hamburg, and Belgium is creating one near Antwerp, but France has only a small refinery of 12,000 to 15,000 tons' annual capacity, which was built during the war near Limoges, in southwest France, to escape the shelling by the enemy.

In fact, most of the copper-consuming industries are situated in the river Seine basin, and with the increase of transportation costs the Palais plant finds it hard to compete with the refined copper coming from New York, and I imagine the owners would gladly give up the refining of copper if they could find another use for the hydro-electric power which they have developed.

France needs about 125,000 tons of copper a year, mostly in the shape of wirebars, and the question has arisen more than once among the principal consumers as to the advantage of a modern refinery well situated in the center of the consuming district.

The main trouble is to secure sufficient blister copper to make the proposition a paying one; some can be had from Serbia, some from Chile, but without the co-operation of American mines it is not possible to reach the tonnage of 40,000 to 50,000 tons annually required to make it pay.

Labor is comparatively cheap over here, land can be had at reasonable prices, especially if we consider the present rate of the dollar, and fuel is abundant whether it comes from French mines, from England, or Germany.

If my recollection is correct, transportation from Arizona to the Pacific Coast is about $6 per long ton, while freight from California to Havre is $7. This should compare favorably with railroad freight to New York via Galveston plus $5 from New York to Havre.

Frenchmen have a prejudice against any trust, and the renewal of the Copper Export Association is not going to change this feeling. They will use all their endeavors to escape this monopoly. Would this not be the proper time to try to establish a co-operation between some independent producers in the United States and the consumers over here, and erect a modern, well-equipped refinery in France which would easily find an outlet for the whole of its production? R. AUMAS.

Paris, France.

Insurance Engineers

THE EDITOR:

Sir—Some time ago, while on my way up to the Hudson Tube station at Journal Square, I passed a real-estate and insurance office where the title "Insurance Engineers" was boldly blazoned on the large plate-glass windows, and yesterday I noted that adjoining advertisements in the real-estate section of the *Times* carried the words "Sales Engineers" and "Liquidating Engineers."

Can it be that not a few of the increasing number of older mining engineers, thrown out of employment, and who have found it difficult to secure suitable openings in the industry, have gone into this line, or is it only one of those cases where another profession has adopted a title which is at the same time more dignified and *lucrative?* You might inquire through your editorial columns. A. T. WARD.

Jersey City, N. J.

The Tri-State District

THE EDITOR:

Sir—In your issue of *Engineering and Mining Journal-Press* of Jan. 30, 1926, there is an article by E. E. Ellis entitled "Occurrence of Commercial Zinc and Lead Orebodies in the Tri-State District." The author states in his article that the westward extension of the orebodies is marked by the so-called Miami fault. More recent drilling has proven this not to be the case, for minable bodies of ore have been found as far as two miles west of this fault, and future work will probably extend this zone still farther west. He has also been misinformed as to the common usage of the term "hog chaw." The more commonly accepted description of "hog chaw" is an unleached fractured chert which breaks very coarse and ravels in the hole unless care is taken to case it off. Very often, especially if the water stands above the horizon of the "hog chaw," it will rise in the hole like quicksand, making it almost impossible to finish the hole.

Mr. Ellis, though very careful not to commit himself too definitely, has propounded some new ideas with regard to the migration of the ore-bearing solutions and their subsequent deposition, more especially the silica-bearing solutions, which are closely related to the ore-bearing solutions. He states that the secondary chert of the district, which closely resembles in many respects the original chert, has been leached from the eroded portions of the Boone formation to the east, carried in solution, and has then been redeposited in its present position. He infers that the lead and zinc of the present orebodies, presumably of the present Miami-Picher camp, were obtained from the leaner orebodies to the east during the post-Pennsylvanian erosion cycle and were deposited as more concentrated orebodies in their present position *after* the deposition of the secondary chert.

The author's deduction that the deposition of the ore

was subsequent to the deposition of the secondary chert will require some explanation, for if the silica of the secondary chert was obtained from *the weathered and dissolving chert of the same type in the areas to the east*, where, then, does the lead and zinc come from? It is usually accepted as a fact that lead and zinc compounds are more soluble than silica in the form of chert. One would therefore seem safe in assuming that the lead and zinc of the lean orebodies to the east would have been taken into solution long before the silica of the chert, and it is questionable if the lead and zinc would be held in solution while the great masses of secondary chert were being deposited. With the high concentration of the ore solutions which the richness of the orebodies of the Miami-Picher camp would indicate, this delayed deposition is, it must be admitted, very problematical.

Mr. Ellis's article opens up some very interesting problems, and something a little more definite from him would be appreciated in the district.

Joplin, Mo. WILLIAM F. NETZEBAND.

Mining Ventures

THE EDITOR:

Sir—I read with keen interest Mr. Sumner S. Smith's article, "Mining Ventures," published in the March 27 issue of the *Engineering and Mining Journal-Press*. In my opinion, Mr. Smith hits the nail right square on the head nearly every time. There are several million people in this country who have a few hundred dollars to gamble with, occasionally, and they are going to gamble or speculate no matter how many blue-sky laws are passed and no matter how many other laws are passed, and no matter how many dull articles they see in ten thousand magazines and papers, advising them to look, listen, investigate, and beware of anything which promises a return on their money of more than 6 per cent.

Several hundred bucket shops, or dealers in unlisted securities, seem to be raking in an abundance of "shekels" just now, and mining stocks, such as the Gilbert, Nevada, stocks and scores of other wildcat mining stocks appear to be the favorites. Even the "dope sheets" put out by the bucket shops carry conspicuously at the masthead something like this: "The information contained herein is obtained from sources which we believe to be reliable. The stocks mentioned herein are strictly speculative. Statements appearing herein regarding the responsibility or standing of any person, firm, or corporation, or as to the value of any properties, holdings, or securities, are merely a matter of opinion." Fair enough! As Mr. Smith says: "It's the attitude of the public that causes the dollars to flow into the pockets of the unscrupulous promoters"—that is, part of the public.

I agree, generally, with everything Mr. Smith says, with the exception of just one short sentence. He says: "Only years of education in the art of saving and investing will teach the public to look before it leaps." How many years? Offhand, I would say, five hundred or a thousand years, and then the country will be a different country altogether, and the change, in my opinion, will be all for the worse. I like the country mighty well, just as it is, and I have never put on sackcloth and sprinkled my head with ashes, grieving because we are not a prudent people like the French or some other people.

What's the answer? The answer is not Mr. Smith's answer. The honest promoter can cause the dollars to flow into his pocket, or into the treasury of his company. How? By imitating, *in a way*, some of the methods employed by the bucket shops and unscrupulous promoters. I certainly do not mean to say that any one should imitate the unscrupulous promoter, in making false statements. The honest promoter should emphasize the fact that his offering is strictly speculative, but that it has actual merit, and that nothing is guaranteed but a square deal.

The people of this country like the square deal. When a man they believe in, with all their hearts, shouts "square deal," they are about as ready to jump to their feet as they are when the national anthem is sung. Well, then, Mr. Honest Promoter, give them a square deal and, above all, see that you convince them that you are going to give them a square deal.

The great trouble is, the so-called honest promoter does not give the public a square deal, one time out of ten. Nine times out of ten, his mine or prospect is really no good to begin with, and if he would take the trouble to have it examined by some able engineer like J. E. Spurr, or T. A. Rickard, or any one of a hundred other able, common-sense, "hard-boiled" engineers, he would learn that the chance of its ever amounting to anything as a real money maker is about one in ten, or one in a hundred.

Well, then, if the chance is only about one in ten, or one in a hundred, that it will ever become a good, paying mine, he has no business offering it to the public; but if he does offer it to the public, he should state that the probability of its ever amounting to very much is rather poor; but on account of its favorable location as regards cheap power, transportation, near-by smelters, good labor supply, and so on, and on account of its being located in a great mineralized area that has produced some of the greatest mines of the country, the winnings will be ten for one or one hundred for one, if he does "strike it rich"; especially so, as he is offering the stock at a reasonable figure and taking a very small amount of promotion stock for himself, in exchange for his mining ground.

A hundred thousand dollars has just been raised by a man who knows nothing of promotion and who never promoted anything before in his life and never thought of such a thing, and he told the people all the "brutal facts" about his prospect. He told them it was decidedly a long shot, but he impressed on the public that he would have able and honest engineers spend the money and that his backers would get a square deal and he made them believe it. This man did a little advertising in the papers and he wrote his own ads, and he received hundreds of letters, from all classes of people, complimenting him on his simple, truthful, straightforward way of stating the "cold-blooded" facts.

Mr. Honest Promoter, go out and get hold of a real good mine prospect (and they are about the hardest things in all the world to find), and try the experiment of telling the public all the facts about it, and be sure that you make your story "snappy" and attractive. Tell everything. Tell the people it is strictly a speculation, and everything else from A to Z. Hold back nothing, and, above all, convince them, if you can, that they will get a square deal, from every standpoint, and then look out! You will be deluged with money.

However, the chances are that you cannot convince the public that it will get a square deal, simply because

you have a very hazy idea yourself as to what constitutes a square deal in a case like this. You probably think honesty of purpose is what constitutes a square deal. Not at all. Honesty of purpose is just exactly 20 per cent of the square deal in this case. Show the public that it will get a square deal *one hundred per cent*, and your offering will be oversubscribed so quickly that you will be dazed, provided, of course, that your story is interesting and attractive. There is no particular reason why the public should be interested in dull, unattractive stories about anything.

Of course, a lot of people will pass up your "proposition," because, being greedy and ignorant and unscrupulous themselves, they will prefer the faker's offering of a fortune overnight from a small investment, as "birds of a feather flock together"; but all the people are not ignorant, greedy, and unscrupulous.

Park City, Utah. CHARLES MOORE.

Where Is Truth?

THE EDITOR:

Sir—I have read the letters relative to Meteor Crater, by Dorsey Hager, and a reply by Daniel Moreau Barringer, as published in the *Engineering and Mining Journal-Press*. Some months or so ago there appeared in the Sunday section of one of our leading newspapers an article claiming that the meteor of Meteor Crater had been found. The size of the meteor, its probable tonnage, and the assay value of its constituent metals were given. If this were so, Hager could have kept in the dark, or Barringer reduced his letter by several wave-lengths. But why is a leading Sunday paper permitted to thrust such a hoax upon the reading public of this country? And what is the probable percentage of truth in anything of a scientific nature that the magazine sections of our papers publish?

Kellogg, Idaho. H. L. GOODWIN.

The Right to Restrict Output Worthy of Much Thought

THE EDITOR:

Sir—I have read with deep interest your editorial of Jan. 23, under the title of "The Right to Restrict Output." The progress of modern business is toward consolidation, output control, and indirect or direct price fixing, and the question discussed in your editorial is at this time well put and worthy of much consideration.

It is entirely logical that production should be limited to the demand for that production, and that surplus production placed upon the open market will immediately artificially reduce the price, even below cost of production. It is therefore evident that to hold it unlawful to restrict production deprives the producer of the logical means of protecting himself. It is also true that in the course of events, under the natural economic law of supply and demand, the low price curtails production, but at great loss to the producer. With the producer suffering loss part of the time, the prosperity of the nation is affected, and likewise the prosperity of the individual.

A condition under which production is balanced with consumption would be ideal, but this balanced condition is difficult of attainment and equally difficult to maintain. If the producer is permitted to restrict output without supervision, such as is accomplished by the low price, he would soon gain a monopoly and in all probability would not be satisfied with a just price. The consuming public would be at his mercy, and here lies the danger of legalizing control of production.

On the other hand, the trend toward consolidation is to create organizations strong enough to control production and gain strategic advantage of markets, which is declared unlawful. Unless this is legalized, modern business may be in the same position before the law as the bootlegger.

Modern business should carefully watch proposed special privileges for the aid of the American farmer. In his impotency, the American farmer may be able to gain by sympathetic appeal legislation which modern business is equally entitled to share, and the American farmer, should he be successful, is as much to be feared by the consuming public as is modern business. But if a way can be devised by which modern business and the American farmer may both be able to regulate their output to the demands for their production, without becoming a menace to the consuming public, the right to restrict output should be given them.

Wallace, Idaho. ROY H. KINGSBURY.

Precipitation of Colloidal Silver in Cyanide Solution

THE EDITOR:

Sir—I have noticed that a high lime content (0.05 per cent CaO in the solution to be precipitated), or a solution fouled by the continuous use of large quantities of "black" cyanide, results in relatively poor precipitation. Can it be that lime (to a lesser extent, I think) and some salt derived from the black cyanide have, both of them, when present in certain concentrations, the property of causing precipitation of a small part of the silver in particles approximating colloidal size, so that the higher press tailings are due to the passage through the canvas of silver in the form of precipitated silver that is too fine to be detected visually?

Some time ago when we were running under conditions of high lime and all black cyanide we noticed in samples taken from the press discharge small specks of a lead sponge, which rapidly swelled to a noticeable extent. As there could be no question of defective filter cloth, I assume that part of the lead was precipitated in particles so minute that the ordinary press equipment could not prevent their passage through the press. These particles agglomerated in the solution pipe, and the swelling effect observed was probably due to the taking up of liquid.

However that may be, the point I am trying to make is that the increase in the silver content of the press effluent solution may be ascribed, under certain conditions, not to incompleteness of precipitation but to precipitation in particles so fine, due to the presence of certain dissolved salts, that some can pass through the pores of the most closely woven canvas and be invisible to the eye.

It follows that the best remedy for a high tailing under these circumstances is not the addition of increasing amounts of zinc but a diminution in the amount of salts introduced into the solution. I still consider that the viscosity of the solution plays an important part, but I am beginning to wonder whether the physical form in which silver is precipitated does not also enact a rôle, to which full attention is not usually paid.

Rosario, Honduras. PAUL T. BRUHL.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

UNION OIL COMPANY sustains heavy loss by reason of two tank-farm fires—France makes petroleum imports a government monopoly.

West End Consolidated makes regular shipments—High-grade ore reported at Liberty, Nev.—New Alto lets contract for 450 ft. tunnel.

Zinc mines at Rush, Ark., to resume May 1—Accidents at Joplin cost $44 each—Big Chief mill, Picher, Okla., destroyed by fire.

Mining interests divided on grazing bill pending in Senate—Senator Cameron, aided by Representative James, of Michigan, advocates 6c. duty on copper.

Tom Reed mine acquires interest in Allison mine.

Manganese Valley Mines, New Mexico, make regular shipments 48 per cent ore—Linn Creek, Mo., asks for railway extension to lead mines.

Stripping operations at Hibbing townsite to cease about May 1—Michigan copper mines in position to increase production.

Chester Consolidated acquires claims near Murray, Idaho—Lukens-Hazel mine, Libby, Mont., under lease for development.

Mine power in Ontario $50 to $90 per horsepower-year—Mining Corporation of Canada increases net returns.

South Dakota mineral production $6,597,000 in 1925, with 1,968 men employed.

Two Large Oil-Tank Fires in California Cause Heavy Loss

On April 7 the 300-acre tank farm of the Union Oil Co., a mile and a half south of San Luis Obispo, Calif., at which were stored 7,000,000 bbl. of oil, was the scene of an immense conflagration due to two underground tanks being struck by lightning. Four huge underground reservoirs to which the blaze was confined all day and night boiled over shortly before 1 o'clock on April 8, and flaming oil, sweeping over a dike that had been thrown up, carried the fire to two other reservoirs and twelve surface tanks.

Estimates of oil loss placed the aggregate at approximately 6,000,000 bbl., valued at about $10,000,000. The equipment loss was not estimated. The death list stood at two, A. H. and W. F. Seeber, father and son, respectively.

At Brea, twenty miles south of Los Angeles, another fire occurred on April 8, when, three reservoirs of a total capacity of 2,500,000 bbl. were destroyed. The overflow from these, also aflame, crept to within an eighth of a mile of the western edge of the town. Fire fighters believed that with a continuance of the favorable wind there would be no danger to the town itself, which also is protected by a twenty-acre orange orchard and a ravine between the burning oil and the outskirts of the settlement.

The financial loss at Brea is fixed at approximately $3,000,000. No loss of life was reported at that town.

Officials of the oil company declared it was too early to estimate accurately the damage or to say what percentage was covered by insurance. The Brea fire was also caused by lightning.

Production and Imports of Pyrites Increase in 1925

THE production of pyrites in the United States in 1925 amounted to 170,081 long tons, valued at $650,448, according to the U. S. Department of Commerce. This is an increase of 6 per cent in quantity, but only 1 per cent in value, compared with the 1924 output, which was 160,096 long tons, valued at $645,262. In 1925, as in 1924, the pyrites production was made in California, New York, Ohio, Virginia, and Wisconsin. The combined production of California and Virginia was 163,773 tons, 96 per cent of the total for the country. Imports of pyrites in 1925 amounted to 276,385 long tons, valued at $773,925, compared with 246,737 long tons in 1924. Nearly all of the imports came from Spain, with small amounts from Canada.

Aurora Lead Mine to Be Reopened

The Aurora lead and zinc mine, near Springfield, Mo., will be reopened soon. It was closed down just after the close of the World War, when the price of lead and zinc ore experienced a sharp decline.

A new company headed by W. F. Scott and M. G. West, of Kansas City, Mo., was organized a short time ago to operate the property. Charles Hargiss has been named superintendent. Active operations will be under way very soon. Mining machinery will be ordered for immediate delivery.

Important Deep-Level Exploration Work at Eureka, Utah

The Thomas Kearns-James Ivers interests, of Salt Lake City, have acquired a substantial holding in the Gold Chain mine, at Eureka, Utah. The plan is to develop the property from the 1,800 level of the Lower Mammoth shaft, now being used by the Empire Mines Company. Drifting will be begun to explore the Chief Consolidated, the Eagle and Blue Bell and other series of limestone which in Tintic properties have been productive of large amounts of ore.

Installation of equipment by the Chief Consolidated Mining Co. in its Eureka Lily property, Eureka, Utah, has been undertaken with the idea of exploring the property for the extension of the Tintic Standard ore channel.

Changes have been completed at the Iron Blossom property of the Tintic Standard near Eureka, Utah, which will permit operations at a depth of 2,200 ft. Production of the Iron Blossom has come from the 1,100 level and points near the surface. After sinking the No. 1 shaft to the 2,200 level and doing a small amount of work, the company gave up the search for ore in the lower horizons. Tintic Standard officials have decided to pursue an aggressive campaign to determine the amount of mineralization in the limestone series.

Hospital Boat on the Yukon

A floating hospital manned by a doctor and two nurses will soon be plowing up the Yukon River taking expert medical service to the natives along the 4,000 miles of its navigable waters.

The increase recommended to Congress will make possible this extension of the medical service of the U. S. Bureau of Education. In addition to making calls to treat the sick, the medical staff will also make a sanitary survey of the entire situation and instruct the natives how to care for themselves. The boat will be launched at Nenana as soon as it can be made ready after the passage of the appropriation. Other extensions of the medical service will be authorized by Commissioner Tigert and announced later. This service should be of some assistance and comfort to prospectors along the Yukon.

Big Jim Mines, Inc., Completes 75-Ton Flotation Mill

The Big Jim Mines, Inc., in the Harshaw district of Santa Cruz County, Patagonia, Ariz., has completed the construction of its 75-ton silver-lead flotation plant. The principal products are silver-lead, but as indications point to the existence of copper and zinc at depth, this condition is planned for and can be met without remodeling. The company has an assured tonnage for more than eighteen months.

Western Development Acquires Red Hill Mine

The Western Development & Mining Co. has recently taken over the Red Hill mine from Albert J. Fitch. This property is 28 miles southwest of Hachita, N. M., and has produced considerable high-grade lead-silver ore. The shaft is 300 ft. deep and is still in oxidized ore. Plans for sinking the shaft and developing the property are under way. Horace Lunt, mining engineer, of Denver, is in charge.

Manganese Valley Mines Make Regular Shipments

An additional unit to the mill has been added by R. H. West, lessee, of the Manganese Valley Mines. The property is in the Little Florida Mountains, 13 miles east of Deming, N. M., and has been producing about ten tons of finished product per day (48 per cent Mn) for the last six month. Shipments are going forth steadily to the Pacific Coast and the Tennessee Coal, Iron & Railroad Co. at Birmingham, Ala. It is planned to put in a grinder at an early date to meet the requirements of the paint trade.

Como-Pima Reports Bonanza Silver Vein

The Como-Pima Mining Co., which a year ago purchased of the Stepp brothers a silver mine in the west slope of the Comobabi Mountains, south of Tucson, Ariz., is reported to have struck a 5-ft. ledge of bonanza silver ore in the Chicago shaft. The new orebody is in a vein lying parallel to the Chicago vein which has been the source of most of the mine's previous production. All ore assaying $75 per ton or more is being sacked for shipment and the rest is put on the dump to be milled later. A 50-ton mill has been built, but is not being operated, on account of a shortage of water. Carl Erickson is general manager.

South Dakota Mineral Production, 1925

According to the annual report of the State Mine Inspector, the mineral production for South Dakota for the year 1925 amounted to $6,597,237. This is distributed as follows:

	Tons	Value
Gold-silver	1,596,701	$6,021,259.00
Lithia	1,014	40,900.00
Mica	377	9,430.00
Bentonite	885	3,540.00
Feldspar	2,000	8,000.00
Andalusite	16	635.00
Gypsum	10,031	57,891.00
Iron ore	500	1,875.00
Coal	23,070	59,982.00
Quarry rock	.....	393,725.00

There were two gold producers, the Homestake and Cutting. The average number of mine employees was 1,678. Quarries employed 232 and coal mines 58. There were 476 accidents, of which five were fatal mine accidents and one was a fatal quarry accident; 98 were serious and 372 slight injuries.

West End Consolidated Makes Regular Shipments From Mabel Mine

The West End Consolidated Mining Co., of Tonopah, Nev., has shipped the fifty-eighth car of ore from its Mabel mine, 20 miles westerly from Min . Values have averaged about $120 per ton in gold, silver, and lead. Most of the ore is sulphide.

The first shipment from the Vernetti-Todd lease, on Garfield ground adjoining the Mabel mine on the east, has been made. This car contained 50 tons of sulphide ore, which is estimated to run $150 per ton and is probably an extension of the Mabel vein, although workings have not been connected as yet. The leasers have a shaft down 60 ft. in ore, with some drifting, and have erected a headframe and installed a 15 hp. gasoline hoist preparatory to deeper and more lateral work on the vein.

New Alto Lets Contract for 450-Ft. Tunnel

The New Alto Divide Mining Co., which holds an option on the Star and Exchequer properties, at Cherry Creek, Nev., announces that it will award a contract for driving the Star tunnel 450 ft. The objective will be the downward extension of the Exchequer vein. Two and a half feet of ore assaying $67.50 is being opened in the South vein in the Star property, according to J. W. Walker, manager.

Mining Interests Divided on Grazing Bill

The grazing bill now pending in the U. S. Senate, being a substitute for the Stanfield bill, against which protest was made by the mining interests of the West, is not altogether satisfactory to those who speak for the mining industry of Idaho. Sentiment is divided, representatives of the mining interests in the southern part of the state, with headquarters at Boise, condemning the measure, claiming that the "bill is designed to destroy prospecting in the national forests," whereas in the northern part of the state, the opinion as far as expressed is favorable to the bill. This opinion is supported by specific provisions in the proposed law. After defining the purpose and policy of the bill, Sec. 1 says: "In effectuating this policy the use of these lands for grazing shall be subordinated (a) to the development of their mineral resources." . . . Sec. 212 permits lessees to construct fences, buildings, corrals, and other structures, and adds: "But any such fence shall be so constructed as to permit the ingress and egress of miners, prospectors for minerals, and all other persons who may go on such area for lawful purposes."

Linn Creek, Mo., Asks for Railroad Extension to Lead Mines

As a result of the lead-mining boom at Linn Creek, Mo., citizens of the town will make an effort to have the Missouri Pacific extend a line into the fields. Most of the mining to date has been by the stripping process. About thirty test holes have been sunk, and it is probable that several mine shafts will be put down soon. High-grade ore has been found at depths too far below the surface to permit stripping.

Lukens-Hazel Mine to Be Developed

The Lukens-Hazel mine, near Libby, Mont., has been taken over under bond and lease by Morris Pearson, of Wallace, Idaho. After being extensively developed and equipped with compressor, mill, and water-power, the mine was closed down several years ago. Mr. Pearson plans to sink 400 ft., in the hope of developing additional ore, lead-silver and zinc, and if that proves successful the property has all facilities for production. Funds to carry out these plans will be raised through the sale of fifteen-dollar options, conforming to the ten-dollar option plan successfully used in the discovery and development of the Stratton mine, in the Coeur d'Alene district.

Zinc Mines at Rush, Ark., to Resume May 1

The first mining operations at Rush, Marion County, Ark., since 1919 are in progress at the Morning Star mine. Every building on the property has been put in good condition, and the mili is being overhauled and rebuilt. In 1919, a group of Pittsburgh, Pa., men purchased the Morning Star, Capps, Ben Carney, Red Cloud, and Philadelphia mines, which during the high-priced period were heavy producers of zinc carbonate ore. Operations are in charge of J. K. Lyons. The capacity of the mill during the last period of operation was 200 tons per day. When rebuilding is completed and the mill is equipped with modern machinery, it will have a capacity of 300 tons.

Mr. Lyons says the company expects to start milling operations not later than May 1. During the era of high-priced ore, the mill was crowded, and much of the fine ore went into the "chat" pile. Numerous assays of the

"chats" show them to carry from 2¾ to 4½ per cent metallic zinc. The entire "chat" pile will be re-milled first. While this work is in progress headings will be opened in the ground.

The Capps and Ben Carney mines adjoin the Morning Star, on the same level, and ore from these properties will be milled at the Morning Star mill. They are connected with a tram road around the side of the mountain. The Red Cloud and Philadelphia mines are equipped with mills. These will be rebuilt and put into operation as soon as the work at the Morning Star gets well under way.

Overhead costs will be somewhat reduced when a highway that is now being built from Yellville, the shipping point, is completed. Hauling costs will be about one-half what they are now, which will save about $2.50 a ton.

Stripping Operations at Old Hibbing Townsite Cease May 1

Stripping by the Oliver Iron Mining Co., on the North forty at Hibbing, has continued all winter from Dec. 1 and will stop on May 1, a monthly average of about 200,000 cu.yd. being removed, or a total of 1,000,000 cu.yd. This brings the stripping edge close to Center St., in the old section of town. The view shows the new practice of laying loading track grade behind the shovel about 8 ft. higher than the shovel level so all spillage from the 8-yd. dipper will fall clear of the car tracks and can cause no trouble or require men for track cleaning. This spillage is cleaned up later by a small shovel. Thirty-yard dump cars are being used, eight to a train, and four trains are kept busy.

Steam-shovel excavation, showing elevated loading track grade back of shovel. At right is a train on elevated grade

Balaklala Mine to Be Opened

The Balaklala mine, near Coram, Calif., has been leased by the Mason Valley Mines Co., which is now operating its mines in Mason Valley, Nev., and is making preparations to reopen its smelter at Thompson, Nev. Necessary camp conveniences are to be erected at the Balaklala mine to replace the buildings destroyed by fire some time ago. The power line will be rebuilt and operations started as soon as facilities for working are installed. The Balaklala ore is needed at Thompson chiefly for its iron and sulphur content.

Quicksilver Production in 1925

Quicksilver production of the United States in 1925 amounted to 9,174 flasks, of 75 lb. each, according to the U. S. Department of Commerce, as compared with 10,085 flasks in 1924. The 1925 production was from seven mines in California and six in Texas, Nevada, Arizona, and Idaho. Based upon the average New York price per flask for 1925, $83.128, the value of the year's production was $762,616. Imports of quicksilver in 1925 amounted to 22,781 flasks. Exports were 204 flasks.

Michigan Copper Mines in Fair Way to Increase Production

In the Michigan copper district, Quincy's Pewabic vein is being opened by two drifts at the 86th level of No. 2 shaft. The vein continues of good width, with copper content fully as good as when first opened. Though the lode apparently is not mineralized above the 83d, where it also was cut in No. 6 shaft, 1,500 ft. from No. 2, there are good prospects that values extend to depth. The rock contains a good percentage of silver.

Ahmeek, a unit of Calumet & Hecla Company, is maintaining a high production rate, shipping 3,750 tons of rock daily from its three shafts. In all three, new ground opened is kept well in excess of tonnage mined, and the yield should average 30 lb. or better per ton. In No. 2 shaft, hoisting facilities are taxed, and a new hoist will be necessary to carry this shaft down to a depth of 10,000 ft., made possible by the purchase of additional territory two years ago.

At the Calumet & Hecla smelter, where production is between nine and ten million pounds of refined copper per month, two large and nine small furnaces are in operation. With the completion of the third large unit, which will be used for refining, the smaller furnaces will be abandoned.

Copper Range will show a gain in production in April. The company has added to its underground force during the last few weeks, which accounts for the larger production. All three mines, Champion, Trimountain, and Baltic, are opening good ground at depth. The excessive flow of water in No. 4 Champion shaft has appreciably subsided. Mohawk, which made a creditable showing in 1925 in respect to costs and earnings, should considerably better production this year. The company also has been adding to its underground force of late and should have no difficulty in maintaining production at the capacity of its mill. Daily rock shipments are 2,500 to 2,600 tons. Yield is close to 26 lb. of refined copper per ton.

Chester Consolidated Acquires Terrible-Edith Claims

The Chester Consolidated Mining Co. has taken a bond and lease on the Terrible-Edith group of claims, near Murray, Idaho. This company is controlled by Pontiac, Mich., people, and is now engaged in carrying out extensive development of the Chester property, near Kellogg. The bond on the Terrible-Edith is on a basis of $50,000 for the property. An initial payment of $2,000 was made on March 30, and $10,000 is payable in thirty days. Ninety days thereafter another payment of $10,000 is due, and the final payment of $28,000 is due six months later, making the total period ten months.

The Terrible-Edith is developed by four tunnels, the lower one now being the main source of ore supply. On this level the oreshoot is reported 600 ft. long with an average width of three feet, much of it being high-grade lead ore with considerable zinc. The silver content is low.

Operations of leasers in sorting the ore for shipment have resulted in an accumulation of milling ore on the dump estimated at 160,000 tons, which will average 10 per cent lead. The Chester company plans to erect a mill of 100 tons' capacity. At the same time the ore will be further developed by sinking 200 ft. from the No. 4 tunnel, following the ore. Immediate plans also include installation of a larger compressor and electric power.

High-Grade Ore Reported at Liberty, Nev.

Liberty, Nev., 26 miles north from Tonopah, is the scene of a small stampede brought about by discovery of high-grade ore about two miles north of the old Liberty mine. All ground adjacent to or in the vicinity of the main strike, which has been incorporated as the North Tonopah King Mining Co., has been located, and other incorporations are in the embryo stage.

The old Liberty mine was a producer of high-grade ore before the days of Tonopah, but production in recent years has been limited and not profitable. Values are in gold, silver, and copper, occurring in quartz veins of up to 20 ft. in width.

News From Washington

By PAUL WOOTON
Special Correspondent

Senator Cameron, of Arizona, Advocates 6c. Duty on Copper

A concerted effort to get copper off the free list apparently has started. Representative James, of Michigan, fired the first gun a week ago. This was followed a few days later by a two-hour speech in the Senate by Mr. Cameron, of Arizona, who says African copper can be laid down at New York for 4.8c. a pound and that the situation of the domestic industry is desperate. It also is known that data concerning the present situation in copper are being gathered for the President. The U. S. Tariff Commission has kept in close touch with the matter, and representatives of producers favoring the duty have been active in acquainting the commission with their arguments for the duty.

Low-cost copper from Africa and South America, says Senator Cameron, already has destroyed our control of the foreign market and unless an import duty is made effective will drive domestic producers from the home market as well. An extract from Senator Cameron's remarks before the Senate follows:

"The menace to our domestic copper-mining industry from the Katanga reserve is not only that of cheap labor and the enormous volume and high grade of the ore reserves, but also the unusual stratigraphic position of same. In the Katanga reserve the ore lies at the surface, and its tonnage can be mined with steam or electrically operated ore shovels. The operators do not have to sink costly shafts or run and maintain expensive underground workings; no costly hoisting and pump equipment or maintenance charges therefor have to be met. No timber for mine supports or enormous quantities of power for ore hoisting and pumping mine waters are chargeable against their mine output. Accidents to their employees will be at a minimum, and they will be able to recover all their ore.

"Due to the vast supply of cheap hydro-electric power available plus the factors aforegoing enumerated, there is no question but that the Katanga reserve can be shovel mined at a cost not to exceed 50c. per ore ton, or about one-half of 1 cent per pound of copper produced.

"The Katanga reserve ore is seemingly an ideal leaching ore. It is estimated that about 95 per cent of the copper is recoverable by this process and should not cost to exceed $3 per ore ton, or 2.3c. per pound of copper produced. The cost of freight to New York and additional refining and selling should not exceed 2c. per pound of copper produced. The aggregate of these cost factors denotes that Katanga reserve copper should be laid down in New York at a cost of about 4.8c. per pound. In view of the foregoing cost factors it is certainly reasonable to assume that Katanga reserve copper will be delivered in New York at a cost not to exceed 6c. per pound.

"Katanga reserve can easily mine and leach 20,000 tons of ore per day and maintain this rate for years to come. This means an annual production of 900,000,000 lb. of copper which can be delivered at New York at a cost not to exceed 6c. per pound. . . . In view of this difference in cost, amounting to about 6c. per pound, why is it that the controlling financial factors within the domestic copper industry have not energetically sought and secured a 6c. duty on import copper?

"The cost of producing copper by two domestic corporations was 11.5c. for their 1923 United States production; and these same two corporations control the large copper reserves of Chile and can lay down in New York 1,100,000,000 lb. of copper per year at a cost of 6c. per pound. With copper selling at 14c. per pound at New York, it is evident that these two corporations can only make 3.5c. per pound on their United States output, as against 8c. per pound profit from their Chilean mines output. Which of these two channels of profit will be followed and developed to its maximum by the undeniably shrewd, able, and far-seeing business men controlling both?"

Accidents in Joplin-Miami District Cost $44 Each

Some interesting figures on accidents in the Joplin-Miami field have been worked out by R. V. Ageton, safety engineer for Tri-State Zinc and Lead Ore Producers' Association. He reports that the average time lost per accident during 1925 was 6.33 days; that the average cost per day for each accident was $7, and therefore, the average cost per accident was $44.31.

He refrains from naming mines, but the company having the best record for the year was one which produced an average of 5,128 rock-tons per accident. The poorest showing was 672 rock-tons per accident. Companies that produced only one thousand tons per accident had to charge 4.4c. per ton cost for accidents. Those that produced 2,000 tons per accident reduced this cost by 50 per cent.

Venus Silver Mines Builds Flotation and Cyanide Plant

Deer Trail mining district, in the southwestern part of Stevens County, Wash., is more active than it has been for several years. The Venus Silver Mines Co. is building a flotation and cyanide plant, which will cost approximately $80,000, to treat 51,500 tons of ore on the dumps, and 125,000 tons stored in the mine, and 80,000 unbroken but blocked out. The company has 800 acres, of which about 640 acres are owned in fee. This ore was left by those who shipped high-grade ore in the period from 1896 to 1902, when the companies had to haul 45 miles over bad wagon roads to Davenport, Wash. It is estimated this ore, ready for milling, will average 16 oz. in silver, 50c. in gold, and 2½ per cent lead. The new mill was designed by L. O. Howard, dean of the School of Mines of the State College of Washington.

In this same district the Turk mine has a large quantity of low-grade silver-lead ore and the Togo mine has copper ore that is said to assay $40 per ton.

Big Chief Mill Destroyed by Fire

The Big Chief, located in the northern part of the town of Picher, in Oklahoma, erected in 1918, was burned on April 1. The origin of the fire was not known. Loss was estimated at $75,000, about half of which was covered by insurance. The property was being operated by the S. R. & W. Mining Co., of Miami, Okla., with Homer Seals as superintendent. He says it is the purpose of the company to rebuild the mill at once.

Michigan College of Mines Installs Huff Electrostatic Separator

The metallurgical department of the Michigan College of Mines, at Houghton, has installed a Huff electrostatic separator. It is expected that in addition to its laboratory value the machine will have a commercial application in the Michigan copper district. Experiments already are being performed on the extraction of fine copper from mill tailings, and if successful one of the large problems of metallurgical practice in this district will have been solved. From five pounds of copper upward, per ton of rock treated, are lost in present practice. Other experiments are being planned, and it is expected that a great amount of information will be developed regarding the conductive properties of many minerals.

Tom Reed Acquires Interest in Allison Mine

It is reported that the Tom Reed Gold Mining Co., of Oatman, Ariz., has acquired a 60 per cent interest in the Allison gold mine, which is located in the Baboquivari Mountains 100 miles east of Ajo. The Tom Reed company plans to spend about $250,000 in construction and development work. About three years ago five prospectors, headed by George Dillard, took a lease and option on the property, set up a small arrastra driven by a gasoline engine, and began the milling of surface ore. The output of gold on that small scale was insufficient to carry the operation, so Los Angeles interests headed by C. B. Brown were induced to come into the enterprise. A small stamp mill was installed and a program of deeper development was carried on until the showing of ore was sufficient to interest the Tom Reed company.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Mine Power in Ontario, $50 to $90 per Horsepower-Year, May Pass to Single Control

A circular is being sent to the shareholders of the Northern Ontario Light & Power Co., which states that Nesbitt, Thompson & Co., of Montreal, have submitted an offer to purchase control of the common stock of the company at $75 a share, subject to the stipulation that in case less than 60 per cent of the shares are offered they are not bound to go through with the transaction. Nesbitt, Thompson & Co. already control the Northern Canada Power Co., which supplies the Porcupine and Gowganda fields. The Northern Ontario company supplies the Cobalt, South Lorrain, and Kirkland Lake camps. With the acquisition of the control of the latter, Nesbitt, Thompson & Co. will control all mine power in northern Ontario and will have an airtight monopoly, as most of the companies are tied up for the life of the mine.

Fortunately consumers in this province are not without some recourse if the company acts in too arbitrary a manner. Through the development of the Quinze power in Quebec, the Northern Canada is in a position to supply the Rouyn field. The Noranda, however, is holding off, and unless it can secure power at a satisfactory price, will develop its own. With the exception of the Hollinger, practically all the mines pay a minimum of $50 per horsepower-year, and power in the Kirkland Lake camp costs as high as $90 per consumed horsepower. The Noranda company believes it should obtain power at about $30, and unless a satisfactory contract is entered into with the Northern Canada, will probably develop its own power.

Alderson-McKay Encounters Good Ore

Conditions in the Quebec copper-gold field continue to be eminently satisfactory. The Noranda grows bigger almost daily and a large amount of work is being done throughout the district. Sixteen diamond drills are operating in the Rouyn section, and the latest property to report new and important developments is the Alderson-McKay, about 12 miles west of the Horne. The first diamond drill to be put down on this property has cut ore at a vertical depth of 100 ft., with very satisfactory results. Since February two new orebodies have been uncovered, making a total of six in all. A new body of zinc ore has been found, which shows 9 to 12 per cent zinc, and a new copper orebody has been uncovered with copper content up to 9 per cent and gold and silver values of approximately $1.60 over widths of 15 to 20 ft. The property is under option to N. A. Timmins.

Cold Weather Aids Transportation to Red Lake

Continuance of the cold weather has helped out transportation into the Red Lake field, and it is understood that all the supplies for the Dome and the McIntyre are on the ground. During the coming summer transportation companies will operate to both Hudson and Sioux Lookout. The Red Cross has established an emergency hospital, and two banks have established branches at Hudson. The gold fever has broken out in a new spot, and there is a good sized rush to Woman Lake, about 40 miles east of Red Lake. A number of claims have already been staked. It is believed that the country for 60 miles east of Red Lake offers excellent prospecting ground.

Dome Produces in Excess of $1,000,000 in First Quarter

During March the Dome Mines, of Porcupine, produced $344,933, compared with $329,689 in February. For the first quarter of the year the output was $1,002,946, against $1,052,863 for the same quarter of the preceding year. Though the grade is somewhat lower the tonnage treated is larger.

Mining Corporation Increases Net Returns

The annual report of the Mining Corporation for the year 1925 is the best statement issued for a number of years. It shows an increase in output of approximately 50 per cent; profits, after all charges, of $602,000, compared with $67,000 in the previous year, and net cash assets of $1,190,000, compared with $850,000 in the previous year. Production from the Cobalt properties amounted to 898,000 oz. and from South Lorrain 1,134,000 oz. At the end of 1925 the company had produced a total of 40,372,203 oz.

The same company operates the Lorrain-Trout Lake. During the year there was shipped to the Cobalt Reduction mill at Cobalt, 12,813 tons, of an average assay of 22.26 oz., giving a recovery of 248,720 oz. In addition 125 tons of high-grade ore, containing 187,582 oz., was shipped to the smelter. Total production was 436,302 oz., compared with 263,912 oz. in the previous year. Total costs were 57½c. an ounce, and settlements, including cobalt, 70.37c. an ounce. The actual profits for the year were $67,270, and dividends amounting to $150,000 were paid, leaving a balance of $34,684 to be carried forward. Net cash assets at the close of the year amounted to $106,800.

La Rose Changes Officers

The annual meeting of the La Rose Mines resulted in a shift of control and will mean the removal of the head office of the company from Montreal to Toronto. D. Lorne McGibbon, for many years president of the company, was not re-elected, and the new board consists of four of the old members and five representing the opposition faction.

The report of the Nipissing Mining Co. for the first three months of the present year shows that the company mined ore of an estimated net value of $338,309 and shipped bullion and residues and customs ore of an estimated net value of $535,409. Production for the quarter was somewhat lower than for several quarters preceding, but new ore has been found at the Fourth of July shaft in Cobalt.

Copper Causes Discontinuation of Cyaniding at Argonaut Consolidated

The Argonaut Consolidated, in the Kirkland Lake area, in northern Ontario, has been obliged to discontinue the cyaniding process owing to the presence of copper in the ore, and the recovery of gold and copper is consequently limited to about 90 per cent of that contained in the ore. The main shaft, which has been put down to the 1,000 level, encountered an entirely new vein at a depth of 950 ft. The vein contains good values in gold.

Potash Production in 1925

PRODUCERS of potash in the United States report that the output in 1925 amounted to 51,544 short tons of crude potash salts containing 25,439 short tons of potash (K_2O), according to the U. S. Department of Commerce. Sales by producers amounted to 52,823 short tons of crude potash containing 25,802 short tons of K_2O, equivalent to about one-tenth of the potash content of salts imported during the year. Domestic potash materials sold were valued at $1,204,024, f.o.b. plants.

Lake Shore Mines Milling 300 Tons Per Day

Since the beginning of the year, the Lake Shore Mines, in the Kirkland Lake area of northern Ontario, is largely increasing its output, the mill having handled an average of over 300 tons of ore per day. A number of stopes have been opened up above the 800 level. The average width is between 12 and 13 ft., and the ore has a value of $40 to $50 per ton.

Victoria Discovers Two Orebodies

The Victoria Syndicate, of London, has opened two good bodies of ore, previously indicated by diamond drilling, in the Goodenough mine, at Ymir, B. C., which it holds under lease and option. One body has been penerated for eight feet, with the face still in ore. The other has been opened by a tunnel, 140 ft. below the old workings and about 400 ft. below the surface. The tunnel has cut through nine feet of ore, and the face still is in ore. Principal values are in gold and silver, but the ore contains, also, commercial quantities of lead and zinc.

The syndicate has established a camp on the Slave River, near Fort Smith, N. W. T., and has thirty to thirty-five men on exploration work. A wireless message from the correspondent of the *Edmonton Journal* states that the syndicate has stripped a lode 300 ft. wide, but no information as to its value could be obtained. The officers of the company stated that it was only a prospect. They scouted the truth of the rumored discovery of placer platinum in the river, despite which, however, the river has been staked for miles along each side, and prospectors continue to arrive.

London Letter

By W. A. Doman

Special Correspondent

Flotation of Panama Corporation Held in Abeyance Pending Financial Arrangements

London, March 29—The Panama Corporation, Ltd., to which I made reference some weeks ago is, I understand, held up temporarily. The capital is mentioned as £2,000,000 in £1 shares, of which £500,000 is to be offered for subscription at par. Originally the directors suggested were Duncan Elliott Alves (chairman), Andrew Percy Bennett, C.M.G. (formerly British Minister to the Republics of Panama, Costa Rica, and Venezuela), the Earl of Cavan, Percy St. Clair Matthey (chairman of Johnson, Matthey & Co., Ltd.), Henry Ludwig Mond (director of Mond Nickel Co., Ltd.), and Herbert Langham Reed (chairman of Kerr, Stuart & Co., Ltd.). From what I can gather there will be changes in the board before the company makes its appeal to the public.

One of the causes of the delay in appealing to the public is, I gather, that advice has been tendered to the promoters that there might be some risk of the capital not being subscribed if the money is required merely for exploration purposes. It is pointed out that to solicit so large a sum to prove properties is rather unusual and that the formation of a smaller syndicate to get results first would have better chances of success. The British public are good "sports," but the view has been expressed in the City that a more reasonable amount of capital would be preferable at the outset as, when results are obtained, it is always easy—if they are good—to raise additional funds on favorable terms. Though I cannot confirm the rumor, I have had it suggested to me that some of the people who were rushing for participation in underwriting at first are now thinking. Panama being a kind of *terra incognita* in this country—at least so far as the present mining generation is concerned—a good lead is wanted to get the public to subscribe.

According to a report from Brussells, as soon as the railway connection is established in Katanga, the Union Minière will begin development of the Prince Leopold mine, reported to be one of the richest copper mines in the world both as regards tonnage and values. It is estimated that about two years will elapse before returns can be made.

The directors of the Central West Mining Co., which took over the old Princess Estate property (West Rand), have issued the promised statement as to the discrepancies in some of the returns last year, when results failed to come up to expectations. It appears from Mr. Homersham's report that credit was taken in one month for gold to be won in the next, so that the yield was counted twice; also, stope values have not come up to the original estimates. I understand that when the Central West was formed, the idea of one of the founders was to show the big South African finance houses how to run a mine. So far the illustration has not proved a good one, and it has to be admitted that the shortcomings lie with the technical management.

Baldwin Gold to Be Reorganized

Plans for the financial reorganization of the Baldwin Gold Mining Co., operating at Swastika, in northern Ontario, will be submitted to the shareholders at a meeting to be held on April 29. It is proposed to organize a new company capitalized at 2,000,000 shares of $1 par value each, and to issue 500,000 shares of the new company, which will be known as Baldwin Consolidated, in full payment for Baldwin Gold Mines.

Electric Power Line to Goudreau Gold Field

The Insull interests, of Chicago, have detailed a party of five engineers, headed by C. J. Nelson, to begin construction work on a $150,000 power line from the power house at Michipicoten Falls to the Goudreau gold field, in the Algoma district of northern Ontario. The Algoma Power Company's plant on the Michipicoten River was recently purchased by the Insull interests. The new line will strike the Algoma Central Railway by a direct route, and will follow the railway to the Goudreau gold mine, where it will supply power to a number of mining companies in the vicinity.

France Makes Petroleum Imports a Government Monopoly

A law was promulgated on April 4 which provides that the importation into France of crude petroleum, as well as its derivatives and residues, shall be reserved to the government or persons authorized by the government beginning April 1, 1927, according to the U. S. Department of Commerce. The general monopoly organization and regulations are to be fixed by a special law subject to supplementary administrative rulings, and its provisions may be extended to Algeria and other French colonies by decrees. The law further provides for increases in the import duties and the internal taxes on certain petroleum products.

New Mining Companies Enter Vulture District

It is reported that the fourth new mining company to enter the Vulture district of Maricopa County, Ariz., is now being formed to operate six claims, including the Superior, in the vicinity of the Washington mine, which was recently acquired by the Tonopah Belmont Mining Co. The company is being organized in Superior, Ariz. A short time ago a good ledge of silver bromides was uncovered in a new shaft, and it is here that development work will be started by the new company. C. E. Gilman of San Francisco, who recently took over the Victory group of claims, is also organizing a company and development work is to start at once. The Victory group is located between the Knoucher mine of the reorganized Belcher Divide Mining Co. and the Washington mine.

Johannesburg Letter

By John Watson

Special Correspondent

February Returns of Rand Mines —American Tourists Visit Johannesburg

Johannesburg, March 9—The following crushing results for the month of February, from fourteen leading Rand gold mines, have recently been published. The mines are arranged in order of profits earned:

	Tons Crushed	Value or Revenue £	Costs per Ton s.	d.	Estimated Profit £
Government Areas	152,000	290,746	16	6.8	166,791
New Modder	118,000	267,960	18	6.1	158,777
Crown Mines	195,000	262,130	19	0.8	76,246
Modder Deep	41,000	92,614	15	3.0	61,314
Springs	63,600	119,489	19	11.9	55,911
Brakpan	76,300	123,859	19	0.3	51,263
New State Areas	69,000	117,856	19	8.4	50,210
Van Ryn Deep	63,200	97,333	15	11.9	48,321
Geduld	78,000	113,890	17	1.0	47,325
Modder B	58,000	95,502	19	1.3	40,082
City Deep	89,000	140,309	23	6.5	35,539
Robinson Deep	72,500	.....	17	9.8	27,526
West Springs	43,700	68,811	19	5.4	26,320
Randfontein Estate	186,000	188,418	18	1.7	22,734

This city on March 6 welcomed a party of American tourists, from the S.S. "Orca," who were met at the railway station by the Mayor and his wife, the American Trade Commissioner, the Director of Publicity, and the president of the Martha Washington Club. The Mayor formally welcomed the tourists and H. J. Crockee, director of publicity, made an address on "The Development of Johannesburg During the Past Forty Years." F. B. Colliver, of Chicago, responded on behalf of the tourists, and humorously referred to certain "Connecticut Yanks" in their party, who, on returning home, might get the idea of manufacturing artificial diamonds, as they had once manufactured wooden nutmegs, when the nutmeg crop had failed. The party expressed a wish to take the earliest opportunity to see a gold mine, which desire was granted. This same party of tourists visited Kimberley on March 5, and were shown the old De Beers "big hole." They were entertained to a civic lunch at Alexandersfontein, and when Alpheus Williams, the manager of De Beers, claimed kinship with his guests (having been born at Oakdale), a shout of glad surprise went up.

On the Johannesburg Stock Exchange, during the last week, there has been continuous liquidation of all classes of shares. T. C. Lands have dropped 1s. on the week's balance, with closing sales on Saturday at 64s. 6d. Potgietersrust Platinums have been adversely influenced by an influx of vendors' shares, and the price dropped during the week from 9s. 11d. to 8s. 11d.

Cresson Installs Large Pump

Cresson mines, at Cripple Creek, Colo., has ordered a 1,200 gal. pump. The foundation is ready for it, and with the other pumps now in service the mine will be equipped for most any emergency.

Melbourne Letter

By Peter G. Tait
Special Correspondent

Shortage of Water on Broken Hill Mines—Gold Dredging in New Zealand

Melbourne, March 9—Australia has experienced a very dry summer, and drought conditions prevail in some districts. Broken Hill unfortunately is the center of one of these dry areas, and conditions have become so acute that to provide for the needs of the population numbering 28,000 the supply of the mines has been cut off, compelling them to shut down. For many years there has been a demand for a permanent water supply by the erection of a pipe line from the Darling River, 70 miles away, but the government decided on the erection of a dam on the Umberumberka River. This took the place of the old Stephens Creek reservoir owned by a private company and always an uncertain source of supply. The present is the first occasion that the Umberumberka supply has failed to meet all requirements, but the possibility of throwing the 6,000 men engaged on the Barrier mines out of employment, makes apparent the need for a permanent supply.

The revival of gold dredging in Central Otaga, in New Zealand, is becoming an accomplished fact. The whole district has been the scene of great activity in the past, and the assumption that large quantities of gold still remain in the beds of these deep and swift flowing rivers is, in my opinion, justified. At the same time, the Kawarau enterprise strikes one as a wildcat, the suggestion being that when the dam is erected across the Kawarau River it would be a simple matter to get into the bed of the river and scoop up the gold. It has been proposed to dam the Shotover River also. This proposal, however, has been dropped. Consequently the bed of the Kawarau cannot be drained, although the volume of water in it may be considerably reduced for short periods.

The Thames is one of New Zealand's oldest gold fields, and, like so many others, it has fallen on evil days. Considerable interest, and even concern, has been occasioned by reports that German investors have acquired an option over one of the mines. The free-milling surface ores have already been treated, but the complex gold ores containing zinc, lead, antimony, and other metals, have defied treatment. A sample of ore from the Sylvia mine was sent to Germany prior to the war, and a satisfactory return was received. Since then the Sylvia, Monowai, and other mines have lain idle, but it is evident that the prospects are considered sufficiently encouraging to warrant further investigation, and if German metallurgists can solve the treatment problem, the Dominion has most to gain.

Shotover River dredge, now under construction in New Zealand

Don Rouyn Copper Discoveries Confirmed

Reports as to the importance of discoveries on the property of the Don Rouyn Gold Mines, Ltd., operating in the Rouyn area of Quebec, are officially confirmed. Exploration work has been concentrated on No. 1 group in Rouyn Township, located between the Noranda and Amulet properties in the northern section of the township. Two other groups lie to the south in the same district. One of the orebodies discovered assays 15 per cent copper, with considerable showings of silver and gold, and another body shows 13.2 per cent copper with gold and silver in smaller proportions.

The orebody runs east and west, and 8-ft. test pits and magnometer readings indicated an orebody well mineralized across 300 ft. and traced for 700 ft. east and west. The original find was near the Powell property on the west. Four other orebodies are indicated in the same group, and diamond drilling on all the deposits will begin soon.

Dip-needle exploration on the original vein indicated a width of more than 100 ft.

Flin Flon Copper Under Development

J. P. Watson, head of the Mining Corporation of Canada, announces that plans have been adopted involving the expenditure of between $10,000,000 and $15,000,000 for the development of the Flin Flon copper area in northern Manitoba as soon as a railway line is built into the area and tests for the treatment of ores are completed. The company's plans include the erection of a smelter with a capacity of 2,000 tons per day, the development of 30,000 hp. on the Churchill River, and the establishment of a townsite. Application for a railway line branching from the Hudson Bay Railway to the center of the Flin Flon mining area has been made to the Legislature of Manitoba. The estimated cost is $3,500,000.

Joseph Myers, of Bingo Gold, in Court

The trial of Joseph Myers, managing director of the Bingo Gold Mines, Ltd., operating in the Herb Lake district of Manitoba, began on April 5, at Winnipeg, before Judge Curran. Myers is charged with making a false statement with intent to deceive while acting as director for the company. The Crown has subpoenaed thirty-five witnesses. Myers is represented by R. A. Bonnar, K. C., H. P. Blackwood, K. C., A. M. Shinbane, and L. D. Morisnick; R. B. Graham, K. C., and E. H. Crawford are prosecuting on behalf of the Crown.

Gorge over which it was necessary to transport dredge machinery

Snow Assures Ample Supply of Water for Mining

There was a heavy snowfall all over Colorado during the last ten days in March, and though it slowed up mining activities for the moment, it will mean plenty of water in the summer, when it is needed. In the Eldora section near Boulder the snow was fifteen feet deep and the mining camps were isolated.

Situation at the Mines

By Albert H. Fay
Assistant Editor

THE month of March experienced a big slump in industrial and mining stocks, and accompanying this decline was a slight drop in the price of the metals copper, lead, silver, and zinc. It has not, however, seriously affected mining operations. On the contrary, there seems to be considerable activity in development and exploitation of mining properties, especially those where there is a possibility of producing gold.

Average Prices, September, 1925, to March, 1926

Period	In Cents Copper	Lead	Zinc	Silver
September, 1925	14.376	9.508	7.753	71.570
October	14.300	9.513	8.282	71.106
November	14.353	9.739	8.614	69.223
December	13.866	9.310	8.565	68.889
Average, 1925	14.042	9.020	7.622	69.065
January, 1926	13.822	9.255	8.304	67.795
February	13.999	9.154	7.759	66.773
March	13.859	8.386	7.332	65.880

Copper—In the Michigan copper district the Calumet & Hecla has completed the installation of a vertical pump line and also a vertical electric conduit, each being 5,300 ft. long, for handling water from the lower levels of the mines. The intensive development and exploitation recently carried on in the Michigan district has resulted in increasing the ore reserves of the various mines. The Quincy has encountered the extension of the Pewabic lode, which gives assurance of larger ore reserves. March production of refined copper, estimated, in the Michigan district was 13,885,000 lb. Calumet & Hecla Consolidated and its subsidiary, Isle Royal, produced 9,050,000 lb.; Calumet reclamation plant, 1,700,000; and Tamarack reclamation plant, 850,000. Mohawk produced 1,350,000 lb.; Quincy, 1,100,000; Copper Range, 1,800,000; and Seneca, 585,000. Seneca's output is based on a daily rock shipment of 1,000 tons, yielding 22.5 lb. per ton. Copper has been moving steadily by rail throughout the winter, owing to favorable freight rates to Detroit and other lower Michigan points, and as a result there will be little metal as compared with other years for the first boats upon the opening of Lake navigation. The year-round freight rate by rail now is 30c. per 100 lb. The Lake rate is 20c.

The first unit of the Noranda smelter, in Canada, is to be of 1,000 tons' daily capacity, and the work of transporting the building material and equipment to the new field is now under way. The Anaconda Copper company is rebuilding its timber mill at Rocker, Mont., to replace the one destroyed by fire. In Arizona the New Cornelia company is producing at the rate of 6,000,000 lb. per month. The Kay Copper company's recent development program has added materially to the reserves on its 1,200 level. Experiments are being conducted on a large scale in the Phelps Dodge smelter at Clifton, in the refining of copper. There are now no places in Arizona where raw copper can be refined, and all copper in the state is shipped east. Electrification of shovel equipment at the Utah Copper mine has proved satisfactory. The next improvement of the company's operations will be the installation of electric locomotives to replace steam equipment. The company is now operating at a comfortable capacity, but will gradually increase production with a better demand. Plans of American copper producers for a revival of an Export Association to operate under the provisions of the Webb-Pomerene act have been submitted to the proper authorities at Washington and will become operative as soon as the necessary government sanction has been obtained.

Gold—The decline in the production of gold in the United States from $101,000,000 in 1915 to $49,000,000 in 1925 is causing some concern among the Western Congressmen. The Bureau of Mines and mining organizations are considering the possibility of lowering costs and the utilization of lower-grade ore. These seem to be the only two remedies in sight. While this problem is being discussed at Washington, the strike at Red Lake, Canada, continues to be the cause of considerable excitement across the border, and a large number of claims have been staked. Substantial mining companies have acquired interest therein and are busily engaged in transporting equipment for the development of the new field. In Ontario the McIntyre mine is handling about 1,400 tons of $9 ore daily, being the second largest gold producer in Canada. The Hollinger gold mine, of Ontario, is producing approximately 6,000 tons of $8 ore per day. The Dome Mines has exercised its option on the Red Lake property and is sending in equipment for further development. The Premier Gold Mining Co., of British Columbia, has just completed a 1,500 hp. plant, which will give it more power for handling its mine product. It is also reported that gold has been discovered at Kramer, Calif., and a mild stampede has resulted. There is a general revival in the gold-mining industry in California, especially at Grass Valley and Nevada City, in the northern part of the state, and at Mohave and Randsburg, in the southern part. At Goldfield, Nev., it is reported that diamond drills have proved the extension of the main vein which made Goldfield famous in years past. In Arizona, the Hassayampa Gold Placer Co. has placed an order for a dredge to be operated on gravel owned by the company. An important gold discovery has been reported from Panama, but it cannot as yet be verified. It is backed and financed by a British syndicate, which has given out practically no information concerning the discovery. The Post Office Department issued a fraud order on the Lightning Creek Gold Gravel & Drainage Co., Ltd., of British Columbia.

Silver—No new developments are to be reported in the silver industry except possibly the action of the silver producers in trying to have Congress pass the Pitman bill for the purchase of about 14,000,000 oz. of additional silver. The Park Utah is the largest producer of silver in Utah, with about 400,000 oz. per month; the Tintic Standard produces about 360,000 oz. per month, and the Silver King 200,000 oz. per month.

Lead—The Consolidated Lead & Zinc Co., operating in the Joplin-Miami district, has increased its mineral holdings and is now one of the largest producers in the district. The Tintic Standard of Utah is the largest lead producer in the state. The Tamarack & Custer mine, in the Coeur d'Alene district, Idaho, has found the extension of the Monroe vein 700 ft. below the upper workings, which will add a large amount to its ore reserves. It is also reported that preparations are being made to recover the lead in the slime accumulated in the Coeur d'Alene River of Idaho.

Zinc—The recovery of zinc as a byproduct from so many copper and lead-silver properties has resulted in the supply equaling or exceeding the demand. As a result a number of the mines in the Joplin-Miami district have gone on a five-day week basis. This method was decided upon as the most feasible means of meeting the problem of overproduction, which has resulted in an excess weekly output in this field from 1,500 to 2,000 tons over smelter requirements. The Wrigley mine, at Santa Catalina Island, California, recently made a shipment of 340 tons of concentrate to Belgium.

Iron—The Bruce Reserve mine, of the International Harvester Co., at Chisholm, Minn., will be one of the new shippers for the year 1926. Rail shipments to the docks have already begun, but on account of heavy ice at Duluth harbor there may be some delay in the opening of navigation, which last year was on April 14. The mines have continued on their stripping operations and the underground mines have been at work all winter stock-piling ore.

Platinum—The Precious Metals Trading Co. was recently organized in Berlin, Germany, for exporting and selling platinum and the associated metals produced in Soviet Russia. Returns are now coming in from the pilot mills in South Africa, some of which are disappointing, and as a result the prices of platinum shares have dropped. The platinum-bearing areas cover about 3,000 square miles. Platinum production for 1925 in South Africa was only about 155 oz.

General—Tin is now a byproduct from the Consolidated Mining & Smelting Co. of Canada to the extent of one and one-half to two tons of cassiterite per day. The International Nickel Co. is planning an $8,000,000 development program near Sudbury, Ontario, work to begin in the early summer. When operations are in full blast, 1,500 to 2,000 men will be employed.

Societies, Addresses, and Reports

Some Problems of the Mineral Industry

Excerpts from an Address by F. H. Probert

ON THE recent occasion of his first meeting as chairman of the local section of the A.I.M.E. of San Francisco, F. H. Probert, dean of the College of Mining at the University of California, discussed broad phases of the future of the mining industry. Portions of his remarks follow:

The purpose of my address this evening is to outline to you, in anticipation of subsequent meetings, a synopsis of the subjects concerning the immediate present and near future of the mineral industry, which may profitably engage our attention and which I hope will be more intelligently and comprehensively presented to you by able men, trained and experienced in the especial fields to which I shall hurriedly allude.

We of the Western states are accustomed to overemphasize our own importance. California ranks third as a mineral-producing state, Pennsylvania and West Virginia being first and second, while Utah, Arizona, and Nevada rank twentieth, twenty-fourth, and thirty-first respectively.

I have no authentic information as to the number of men employed in mining, smelting, or otherwise preparing mineral products for the market, but it is safe to estimate that 1½ per cent of the United States population is directly concerned.

The annual output of the industry has increased in value fifteen times in the last half century, yet we would have difficulty in naming half a dozen great mines that have been made in the last decade. The impetus given to copper production by the advent of the "porphyries" into the field has assured a sufficient supply to meet present wants, but the higher-grade mines are being rapidly exhausted and we are confronted by many difficult problems as grade of available ore is lowered and costs of labor and supples are increased. We are no longer appalled by the bigness of things; we accept them perhaps without analysis. We speak lightly of daily output of five thousand tons, whereas when most of us here present were students at college, a mine of five hundred tons a day was a big enterprise.

Fewer Units

There is, moreover, in spite of increasing output, a notable decline in the number of mines being worked. Mr. Spurr is authority for the statement that in thirty years between 1899 and 1919 the number of mines and quarries in the United States was reduced 40 per cent, while at the beginning of the present decade 90 per cent of our copper came from only twenty-five mines, and yet we contribute 54 per cent of the world's supply.

Wholesale methods of mining, for all the essential minerals, characterize the industry today, but such methods are made feasible only by the control of vast resources—high-grade ore is not found in such quantity; by the availability of large sums of money, by colossal daily output, the result of modified methods, and the substitution of human effort by machinery; by the great strides we have made in the treatment, beneficiation of minerals, in ore dressing, flotation, smelting, and leaching; by the integration of units under competent direction, and by organized, scientific marketing. "From raw material to ultimate consumer" is the slogan.

True there may be attractive outcrops of orebodies mantled by impenetrable masses of snow, or buried deep in tundra, or swamp, or jungle, but there they are likely to remain. The search for new fields has been diligent, and already the cream has been skimmed from the milk, leaving the obscure and unattractive for posterity. Only one mine emerges from 22,000 locations, according to Mr. Robert Talley, of the United Verde.

Work of the Geologists

How shall we continue to search for the mines of the future? A partial though perhaps not satisfying answer is ready at hand. Reason must supplant rule of thumb, the quickening spirit of research must overcome inertia and science must ride in the saddle. . . . I am mindful of, and in no sense belittle, the great work which our leading geologists have done in working up theories and hypotheses that may and do explain the make of the earth's crust and the genesis of orebodies by primary and enriching processes. The rocks, however, do not change except in geologic time, but our interpretation of them seems to alter frequently. Moreover, if you will with unbiased mind examine the many monographs, professional papers, bulletins, reports or other papers descriptive of mining districts I think you will agree with me that the part dealing with the early mining history, the description of surficial signs and an explanation of them, is conspicuous by its absence, or at least assigned to a subordinate place by the elaborate learned discussion of orebodies already known to exist. My point is this: The geologist of today must be more of an obstetrician than physician or coroner. As scientists we are interested in ore genesis, as mining men are concerned in the finding of other mines and in profitable production of the minerals that minister to the wants of mankind.

Instrumental prospecting is, in part, replacing or supplementing the work of the geologist. As our knowledge of the physical properties of earth substances increases, ways and means of determining their presence by delicate and sensitive instruments will be devised. We experience a recrudescence of the polymorphous "doodle bug" and are thereby influenced in our judgment of the many instruments designed to register the effects of physical properties. The magnetometer, potentiometer, seismograph, or torsion balance may point the path to hidden mineral masses. We must not ridicule earnest effort; we dare not summarily dismiss from our thoughts the fruition of mature minds in these specialized fields of investigation. We must not offend our ultra-scientific bretheren, for in the fog enveloping our present practices we may find a beacon light leading to our goal. Thus far we have found little or nothing of commercial importance that may be attributed to the application of these theories.

Room for Progress

Our knowledge of the whole field of prospecting, whether geologic or instrumental, is still in the kindergarten stage, and does not justify the relief from laborious and costly prospecting by drilling or other development work. Many a condemned prospect will be revisited and re-examined and worked by light from the lamp of increasing knowledge. Let it be granted that other mineralized masses will be uncovered. How shall they be mined? They will be of leaner and leaner mineral content, in greater quantity but poorer quality, and in order that they may be worked at a profit, every economy will have to be exercised. Herein many problems present themselves.

The item of taxation may assume larger proportions than that of timber or explosives in the cost sheet, and labor will always loom large in the monthly statement. It is useless to deceive ourselves in these matters. Transportation facilities, supplies, labor, legislation, price tendencies, political conditions—these things determine the color of the ink in our balance sheets as much as geologic occurrence or mineralogic association.

What is the situation? We have low-grade raw material on the one hand, an increasing wage scale for less efficient and more arrogant workmen, costly supplies, and anything but beneficent laws, on the other hand. How are we to mine at a profit. Again I say by the application of scientific principles in management, in practices, by integration of units under central efficient control, by wholesale manufacturing methods and intelligent marketing.

Mountains of ore are now being moved. Grade has given place to quantity, muck stick to steam shovel. Everywhere and anywhere mechanical power has been substituted for human effort, in drills, scrapers, loading devices, and motor haulage. We attack larger unit blocks of ground, and many new mining methods have been devised. The tendency is to make the ground mine itself and to do away with as much material foreign to the place of excavation as may be.

I often think we have progressed too rapidly and that we will be obliged to retrace some of our steps. There is scarcely one of the large mines of the Western states that has not revamped its mining system, not always as the result of increased ore reserves due to

the proven ability to treat successfully lower-grade material than was originally included in the estimate of tonnage. We do not know enough about the way rocks behave under varying conditions of stress and strain. We should know how, when, and where rock will break, how to control rupture or rock movement, how to invite it, and how to compel it.

Need for Wide Vision

In order that advances may be made it is desirable that the most liberal generosity be infused into our discussions. Dr. Douglas, in addressing the students at the Michigan College of Mines many years ago, said, "There is no greater mistake than to work with too intense concentration or with your vision too firmly focussed on your own enterprise. Technical travel displaces many an illusion and prejudice." The law of give and take is of universal force, and there is nothing to be gained by imposing secrecy on company officials. But in order that we may compare notes and exchange ideas it is necessary that we should use understandable terms and speak a common language. I have glanced through the last volume of the *Transactions* of the Institute, that devoted to mining methods. I am disappointed, for the many papers submitted do not present the descriptive data such as will permit of intelligent comparison of practices. Why is this? First of all because we use ambiguous terms, secondly because we speak of dollars and cents rather than tons per man-shift, F.B.M. timber consumed per ton of ore, energy units, and so on. It is common practice to preface the paper by hurried and irrelevant allusions to the geology of the district, then to refer to the high- (or low-) grade ore, whichever it is, as being hard or soft, altered, fractured, but there is no yardstick by which these things can be measured. We use relative terms and meaningless terms at that. Is it not worth our time to standardize our vocabulary? When we speak of ore, or mineral, or waste, do we all have the same interpretation of the words. I shall invite you at some future meeting to partake of a feast of definitions so that we may have fundamental data upon which to build.

I would revert to the benefit to be derived from unrestrained, generous discussion. All of us at times are committed to secrecy, and it might be embarrassing and unethical to tell all we know; nevertheless, there is much thought that would be freshened by being aired, and many an amorphous idea that would have attractive crystal form if expressed. It might prove a nucleus of growth and in the end be an aggregate of information of inestimable benefit. I am thinking at this moment of the guarded actions of our oily brethren. When the Federal Oil Conservation Board was created the halting lips of the oil producer ceased to mumble; they became dumb. Oil production is a competitive industry, for oil differs from all other minerals in that it will not "stay put." It is the greatest of our mining industries; it is the most wastefully developed.

I am not alarmed over the future of oil, for persistent research will make possible improvements in oil-well drainage, still we cannot shut our eyes to the increasing demand for crude and its products. It is urged that the oil-shale industry will prove to be a panacea. Again I see many problems ahead of us. Mr. Schuyler, at the hearings of the Federal Board, spoke to this point, but his arguments are not convincing. He, as have many others, dismisses the subject of mining the shales at a low cost as if it was a thing already accomplished. It is even unlikely that they can be won by the common coal-mining practices, the bulk of the deposits are not amenable to steam-shovel operations, and it may be difficult to apply caving methods to material resembling in character hard rubber, occurring in beds with firm flat roofs. Many engineers have recognized that oil shales will have to be mined before they can be retorted, but few have mentioned the fact that the disposal of spent shale is a problem greater than that of getting rid of the tailing from our largest porphyry coppers.

And even though we perfect the technique of operations, do we realize the magnitude of the task and the influence it may have on our economic structure? For the sake of argument let us assume that five years from now, with the increasing demand for oil, we will have to look for one-quarter of the supply from other sources. This would mean the production of 200 million barrels. If it is to come from the known shales, the early work of the new industry will undoubtedly be in the richer rocks. The average oil content of American shales is 11½ gallons per ton. Assume that 25-gallon shale will be taken. To give the required oil about 350 million tons of shale would have to be mined, treated, and disposed of. On the basis of the Scottish oil-shale industry, this would require the organization of an army of workers 500,000 strong. The capital account would be about 2½ billion dollars. In addition to these primary facilities necessary for the development of our hypothetical shale-oil industry, we would have to provide railroads, pipelines, and for the establishment of large communities of workmen in not readily accessible regions. This subject of oil shales will be elaborated during the year.

Tailing and Slag

The mining industry comprehends more than the mere excavation of mineral substance from its habitat in the earth; it is concerned with the beneficiation of marketable products either to be further fabricated or in form directly available to the ultimate consumer. The urge to produce has, however, given approval to wasteful and slipshod procedure. Conservational measures are not opposed to intensive operations. Industry gives birth to industry and increasing knowledge expands every man's opportunity.

The tail race leading from the mill discharging its slimy content as an unsightly tailing dump or finding its way to pollute the limpid beauty of mountain stream carries many a potential dividend. The metal ingot, bullion brick and clean concentrate are very satisfying things; they are the tangible products of our laborious work; they have an appeal which is pleasing; but what of the metal in this pasty blackening slag? What of the dollars and cents locked up in this muddy mess as it flops and flows from the launder, the offal of the mills!

Thus far in my address I have stressed the importance of the scientific and technologic side of the problems besetting the mineral industry. There remains another side for our consideration, a field perhaps more potent in its influence than any other. I refer to the humanistic aspects of mining.

The Human Element

We can no longer rely upon caprice, contingency, or other fortuitous circumstances, the concomitants of past practices, for the furtherance of mining. Romance must assume another garb, for this generation is not fanciful; it is not to be deluded by fictitious dreams; we have come to an age of demonstration, of tangibility, of realization. We have to reckon with the human unit.

A measure of efficiency may be momentarily obtained from systematic stop-watch studies; standardized this and standardized that may effect savings of materials, but it stultifies initiative, it thwarts ambition, it makes of men machines, automatons. Distressing and disturbing influences have changed the human unit. "We are hampered by class suspicions and misunderstanding, by racial prejudice, by inhibitions of organized labor and lack of imagination in high places," says Dr. Little. There is something more, something deeper. Most men are working or playing "make believe" for wages—not to produce anything. The miner sells his time for $5, or what the prevailing wage is, a day, but it does not follow that he works to get out ten tons of rock a shift. The interest seems lacking, the joy and pride of work is gone. He labors to maintain his physical comfort, not to expand his mental vision. Men have become slaves to a system, mere cogs in the great wheels of industry, but being gifted with powers of thinking, no matter how stultified or aborted they may be, rebellion against this condition of semi-slavery has expressed itself in diverse but definite ways. An oligarchy is repulsive, socialism is an impossible creed, but there is a middle ground wherein capital and labor may meet and be reconciled. Herein lies a most fruitful field of research. We should make excursions into the byways of understanding, adventuring into the realms of human motifs. We should make scientific investigation of civilization by evaluating the personal equation. Dr. Elton Mayo, of the University of Pennsylvania, has recently said, "The problem of unrest is not primarily economic; it is human." Wars and strikes are alike caused by human passion, human irrationality; social revolutions are in the same category. Differences between factions may be settled by reasoned investigation; they will be aggravated by impassioned organization. The science of psychiatry or psychopathology may contribute to the production of mineral wealth as certainly as the science of chemistry and physics.

Recent Technical Publications

Reviews, Abstracts, and References

Economic Geography of South America. By R. H. Whitbeck. The McGraw-Hill Book Co., New York. Price $3.50.

South America is constantly becoming of more importance to mining engineers, and any one who has been there or is considering going there will find much readable material in this book. The characteristics of the people are given special attention, the author having made a social survey of the continent as well as giving a large amount of matter relating to the industrial activities of the inhabitants of the various countries and regions. Political conditions are also dwelt on briefly.

Pit and Quarry Hand Book, 1926. Edited by H. W. Munday. Complete Service Publishing Co., Chicago. Price $5.

The present (fourth) edition of this book exhibits quite a rearrangement of the contents. The technical data and catalog pages are sectionalized into thirty parts, each of which is introduced by an original technical article written by one who is closely in touch with progress in the field that he covers. Practically all of this matter is new and well presented. The book is designed to give practical information for the design, operation, and management of cement, lime, gypsum, sand and gravel, and crushed-stone plants.

The Chemical Engineering and Chemical Catalogue. 2d edition. Edited by D. M. Newitt, Ph. D., B. Sc. (Lond.), D. I. C., A. R. C. S., A. I. C., A. I. Chem. E. Published by Leonard Hill, 173 Fleet St., London, E. C. 4, England. Price 15s.

This volume is similar to the Chemical Catalog published in the United States, it being a directory of sellers of chemical and engineering equipment in Britain. The first section gives the names of the manufacturers or dealers in the alphabetically arranged commodities; the second section contains condensed catalog pages; the third section is devoted to tables and data of a technical nature for reference purposes; and the final section is an index of various commodities arranged alphabetically according to their industrial use.

Lehrbuch der Bergwerksmaschinen. (Kraft-und Arbeitsmaschinen). Von H. Hoffmann. Published by Julius Springer, Linkstr. 23-24, Berlin W. 9, Germany. Price, 24 marks.

The field covered by this work includes thermodynamics, fuels and combustion, steam boilers, piping, reciprocating steam engines and turbines, power and steam hoisting machinery; piston, centrifugal and turbo pumps; piston and turbo compressors; compressed air tools, high-pressure compressors and compressed-air locomotives; refrigerating machines; ventilating machines; internal-combustion engines; electrical power transmission in mines; and measuring instruments. The book is well illustrated and printed and has the appearance of being a good textbook.

The American Year Book, 1925. Edited by Albert Bushnell Hart and William M. Schuyler. The Macmillan Co., New York. Price $7.50.

This annual volume was published for the first time in 1911, continuing until 1920, since when no issues have appeared until the present one, covering 1925. The aim is to resume regular annual publication and thus provide a permanent consecutive record of events and progress in the United States. The book, which contains 1,158 pages, is made up of contributions from 256 authorities in as many important activities. Individual contributions are classified into seven major sections as follows: 1, Historical; 2, American Government; 3, Governmental Functions; 4, Economics and Business; 5, Social Conditions and Aims; 6, Science—Principles and Application; and 7, the Humanities. "The Mineral Industries" occupies 32 pages in the fourth section of the book, with papers on mining and ore dressing by Charles E. Locke; coal and coke, by R. Dawson Hall; petroleum, by A. H. Hubbell; copper, by Leonard S. Austin; gold and silver, by M. W. von Bernewitz; iron and steel, by Edwin F. Cone; zinc, by Walter Renton Ingalls; lead, by Allison Butts; and statistics of mineral production, by Frank J. Katz.

The scope of the book precludes extended discussion of any one subject, so that the specialist will find little or nothing about his own specialty that he does not already know. But if a mining engineer finds himself booked for luncheon with a sculptor, let us say, he can, with the aid of this book, converse with a certain amount of savoir-faire, and not be obliged to admit that he has never heard of any sculptor other than Gutzon Borglum and is not quite sure what finally happened to him. The book should be of much value to any man who writes for publication, to public speakers and teachers, and to any one who wishes to keep abreast of the times in other fields of endeavor than his own. Political events and governmental activities have perhaps an undue amount of space, to the exclusion of matter concerning industrial progress.

E. H. Robie.

Patents

Index of Patents — The Index of Patents issued from The United States Patent Office in 1925, arranged alphabetically according to the names of the patentees and according to the inventions (1,860 pages), is now available from the Commissioner of Patents, Washington, D. C.

Separator—No. 1,576,954. March 16, 1926. D. H. Donegan, Placerville, Colo. A conical separator for removing flaky metallic particles, as of the precious metals, from sand.

Sluice Box—No. 1,577,926. March 23, 1926. F. S. Morgan, Berkeley, Calif. A concentrator or sluice box comprising a trough in which are deep depressions, and over which is a movable cover.

Rock Drilling

No. 1,577,596. March 23, 1926. W. A. Smith, Athens, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. A steel retainer for rock drills.

No. 1,578,383. March 30, 1926. L. C. Bayles and F. M. Slater, Easton, Pa., assignors to Ingersoll-Rand Co., Jersey City, N. J. A throttle valve for rock drills.

Crushing Machinery

No. 1,575,874. March 9, 1926. E. B. Symons, Los Angeles, assignor to Symons Bros. Co., Milwaukee, Wis. Design for a crushing head, for an ore crusher.

No. 1,577,382. March 16, 1926. F. J. Straub, New Kensington, Pa., assignor to Crozier-Straub, Inc., New York City. A pair of crushing rolls in one of which rolling weights are placed for varying the rotative movement.

No. 1,578,948. March 30, 1926. J. R. Bakstad, Chicago. Design for a jaw crusher in which rock is given both a primary and secondary crushing.

Zinc Oxide

No. 1,578,694. March 30, 1926. L. E. Wemple, Cleveland, Ohio. A mixture of metalliferous materials containing a volatilizable metal, solid carbonaceous fuel, flux and compressed air is blown into a furnace chamber heated with extraneous fuel. The reducing agent is present in amount sufficient wholly to reduce the metalliferous material, which is volatilized at the heat maintained in the chamber, and then passed through a tortuous passage in which oxidizing conditions are maintained. The oxidized vaporizable metal is then collected, substantially free from slag.

No. 1,579,302. April 6, 1926. W. T. Gidden, Smethwick, England, and W. G. Ragg, Birmingham, assignors to Chance and Hunt, Ltd., Oldbury, England. Zinc oxide of a high degree of purity is produced from crude material containing an oxygen compound of zinc, by dissolving in ammonium carbonate solution, suddenly diluting the solution with water, and distilling off the ammonia.

Iron-Aluminum Separation — No. 1,575,852. March 9, 1926. C. P. McCormack, Cleveland, Ohio. In beneficiating an oxidized iron ore containing aluminum, the step which consists in roasting the ore with soda ash, whereby a controlled amount of the aluminum is converted into water-soluble sodium salt.

Copper Converting — No. 1,576,777. March 16, 1926. M. H. Merriss, Westbury, N. Y., assignor to the Nichols Copper Co., New York, N. Y. Black copper and similar material is heated until partly melted and then air is blown through the mass until blister copper is produced.

Silica Volatilization — No. 1,577,217. March 16, 1926. Herman Fleck, Golden, Colo., and W. G. Haldane, Denver. Metallic compounds are extracted from concentrates or slimes by treatment with a reagent capable of converting the contained silicon into a volatilizable compound which may be evaporated without loss of the metallic compounds.

Men You Should Know About

R. J. Ennis has returned to Porcupine, Ont., from an extended holiday in the Western States.

J. F. Dugan, of Butte, Mont., is now general manager of the California Zinc Co.'s property at Winthrop, Calif.

A. H. Lawry, superintendent for the Goldfield Consolidated Mining Co., at Goldfield, Nev., is in San Francisco.

Sidney J. Jennings, mining engineer, will after April 30 be located at Room 1600, 57 William St., New York City.

C. E. Julihn has been formally designated as engineer in charge of copper investigations for the U. S. Bureau of Mines.

John G. Kirchen, general manager of the Tonopah Extension Mining Co., at Tonopah, Nev., has returned to Tonopah from San Francisco.

Arthur Keith, of the U. S. Geological Survey, has left Washington for two months, to deliver a course of lectures at the University of Texas.

Charles L. Lawton, general manager of the Quincy Mining Co. in the Michigan copper district, has returned from a business trip to New York City.

Dr. L. D. Ricketts, formerly located at Warren, Ariz., has closed his offices in that city and is now at 325 Pacific Southwest Bank Building, Pasadena, Calif.

E. Craig, manager of the Tonopah mines, of the Gowganda district of northern Ontario, has concluded a visit to the Porcupine district, also in northern Ontario.

Guy H. Ruggles, superintendent of the Inspiration concentrator, at Inspiration, Ariz., recently delivered a lecture before the students of the School of Mines at the University of Arizona.

Russell C. McGinnis, formerly divisional engineer with the Phelps Dodge Corporation, Copper Queen Branch, has accepted a position as valuation engineer with the U. S. Income Tax Unit.

T. M. Banks, of Austin, Tex., has resigned from his position with the Geological Survey of Texas to join the geological staff of the Vacuum Oil Company, with headquarters at Houston, Tex.

W. W. Boyer, of the Conservation Branch of the U. S. Geological Survey, has left Washington for his new field headquarters. His future address will be 212 Customhouse Building, Denver, Colo.

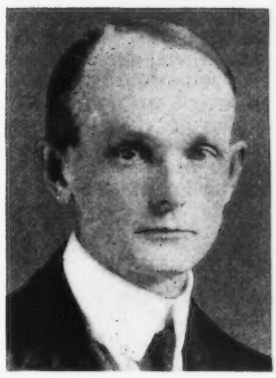
C. W. Cooke, of the U. S. Geological Survey, is now in Florida assisting **J. W. Gidley,** of the Smithsonian Institution, in his investigation of the remains of early man near Melbourne and Vero.

Olaf Wendstrom, manager of Carson Hill Gold Mines, Melones, Calif., was recently in San Francisco en route to Melones from Boston, where he presented reports on present conditions at the property.

A. R. Decary, superintendent engineer for the Province of Quebec, of the Department of Public Works of Canada, was recently elected president of the Corporation of Professional Engineers of Quebec.

Herbert Hoover delivered an address on the evening of April 13 at the opening session of the International Electrotechnical Commission, held at the Engineers Societies Building, 29 West 39th St., New York City, broadcasting from Washington.

Colonel R. P. Cobbold, of London, England, director of the Anglo-Ontario Mines, Ltd., has returned from a visit to the Porcupine mining district of northern Ontario, in which the company is largely interested.



Dr. H. Foster Bain

Dr. H. Foster Bain, formerly director of the U. S. Bureau of Mines, and since last summer secretary of the American Institute of Mining and Metallurgical Engineers, spoke at the Mayo Hotel, Tulsa, on March 29, on "How the Institute Can Better Serve Petroleum Engineers."

N. T. Lindthrop, geologist for the Soviet government of Russia, was in Austin, Tex., recently consulting with the oil and gas division of the Texas Railroad Commission regarding Texas oil production and conservation laws.

E. A. Haggen, mining engineer, who had been in Alaska on professional work, recently crossed from the Pacific Coast to the East through Canada on his way to Geneva, Switzerland, where he will spend some time before returning to his headquarters at Vancouver.

Arthur Jarmen has been engaged by the California State Mineralogist, **L. L. Root,** to make investigations of hydraulic mining conditions in Nevada, Placer, and El Dorado counties, under the provisions of the Cloudman Act, which authorizes a state expenditure of $10,000 for the investigation.

W. J. Deavitt, for many years superintendent of the American Smelting & Refining Co.'s Santa Eulalia unit, in the State of Chihuahua, Mexico, has been transferred to the company's El Paso office. **B. C. Staiger** has been appointed superintendent and **W. H. Holmes** assistant of the above-named unit.

Philip S. Smith, of the U. S. Geological Survey, wired recently from Kotzebue, Alaska, that his entire party expected to reach Kivalina on April 2. Reports on the proposed route were encouraging. All of the party are well and things are working smoothly. The weather has been unusually mild and good.

David White, L. W. Stephenson, W. T. Thom, Jr., and **C. H. Dane,** of the U. S. Geological Survey, have been in Dallas, Tex., to attend the meeting of the American Association of Petroleum Geologists. After the meeting Messrs. Stephenson and Dane will remain in notheastern Texas two or three weeks for stratigraphic work.

Professor J. P. Rowe, author of the article entitled "Petroleum and Natural Gas in Montana," which appeared in the *Engineering and Mining Journal-Press* of April 3, 1926, was incorrectly given the title of "assistant professor" in that article. Professor Rowe has been head of the department of geology at the University of Montana for the last twenty-five years, with the title of professor.

H. W. Hoots, of the Geologic Branch of the U. S. Geological Survey, left Washington recently to attend the meetings of the American Association of Petroleum Geologists at Dallas, Tex., after which he will go to California for field work in the Salinas and San Joaquin Valley. **N. W. Bass,** of the Geologic Branch of the Survey, now assigned to Kansas on co-operative work, also attended the Dallas meeting.

Dr. W. O. Hotchkiss, president of the Michigan College of Mines, Houghton, who has been visiting various mining districts in the West and Southwest for several weeks, is expected home the latter part of April. After his return, definite arrangements will be announced for the copper conference to be held at the college. The conference will organize for research work into problems affecting the future of the copper-mining industry in Michigan.

Obituary

Hector McRae, a well-known mining and oil operator, died in Los Angeles on April 8, after an illness of six months. He was born at Horton's Mills, near Ottawa, Canada, nearly seventy years ago, a member of a family well known for nearly a century in that vicinity. During the last thirty-five years he had visited and operated in many of the mining states of the West, and was well known in the large cities of the world, including London, New York, and Montreal. Recently he had been interested in oil-shale projects in Colorado, and was closely associated with M. J. Trumble in an extraction patent process perfected at Alhambra. He leaves a widow, who left Los Angeles last week to join a son in Windsor, Ontario; two sons, J. W. McRae and J. Donald McRae, of Chicago and Windsor, both of whom fought with the Canadian forces in the World War; and three daughters, Mrs. Catherine Higgins, of Berkeley, Calif.; Mrs. Rose Stewart, of Montreal, and Eleanor McRae, of Milwaukee.

New Machinery and Inventions

Pump-motor Sequence Control Devised

An interesting system of pump-motor control was recently devised by the General Electric Co. for controlling an installation of three squirrel-cage pump motors used to maintain the water level in a reservoir. It was desired that standard automatic starting compensators be used, with an auxiliary control which would give six combinations of the pump motors at six different levels of the water in the reservoir. It was further desired that but one of the pumps operate during certain periods of time, the other two automatically shutting down, to start again only at the end of the shutdown period.

In view of the fact that ice would foul the mechanism of a float switch during the winter months, it was decided to use a Ruggles-Kingmann regulator panel having six control points, each point to represent a definite level of the water in the reservoir.

There were mounted on the panel the regulator, a dial switch, a control circuit switch, a time switch, and seven double-pole control relaying contactors. Rather than make up a new dial switch with six points, a field control switch with twenty-one buttons was utilized, the six points being obtained by wiring the twenty-one buttons into seven groups of three buttons each.

In operation, the water dropping in the reservoir causes the regulator to operate, moving the dial switch to the first control point, actuating contactor No. 1, and starting pump motor No. 1 by means of the first automatic compensator. As the water level continues to drop, additional contactors up to the sixth are actuated. The first pump motor is rated 60 hp., the second, 100 hp., and the third, 150 hp. As each pump goes into operation on the first three points of the dial switch, the preceding one drops out. Pump No. 3 continues to operate on the fourth, fifth, and sixth points, and additional pumps are picked up on each point. On the fourth point, pump No. 1 is added; on the fifth point, pump No. 1 drops out and pump No. 2 is picked up, and, on the sixth point, all three pumps go into operation.

So as to provide for operation of only one of the pumps during certain periods of time, a time switch and one of the control relaying contactors were used. The normally closed tips of the time switch were wired in the coil circuit of the contactor and the control circuits of the two automatic starting compensator panels were wired through the contactor. During normal operation the contactor is closed and all the pump motors start on their respective points. During the period of shutdown, however, the tips of the time switch open and the contactor drops out. As a result, only one pump motor operates, regardless of the position of the dial switch.

A Portable Power Pipe Threader

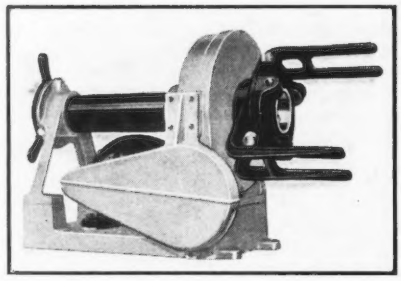
Threading pipe by hand is always a more or less laborious operation, depending somewhat on the size of the pipe. In any case it is slow. To obviate this difficulty the Oster Mfg. Co., of Cleveland, Ohio, has recently developed and placed on the market the new light weight model, power drive pipe threader shown in the accompanying illustration.

As may be seen, the body of this machine is made almost exclusively of aluminum alloy, which is not only stronger and more durable than the cast-iron formerly used, but is much lighter. The new machine weighs only 150 lb. and is therefore a really portable unit in its entirety.

Motive power for this machine is furnished by a ½-hp. reversible universal motor which automatically speeds up on the smaller sizes of pipe yet maintains the necessary speed on the larger sizes. This gives the outfit a greater productive capacity than would otherwise be the case. This motor can be run from any 110 or 115-volt lighting circuit either direct or single phase alternating current, of any frequency. Its reversibility makes it possible to use almost any die stock in connection with the machine.

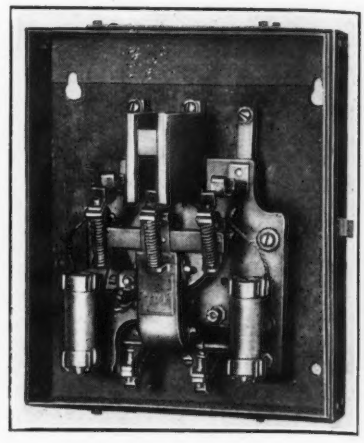
This machine has the capacity to drive any die stock or pipe cutter up to 2 in., but with a special auxiliary drive shaft (which can be furnished) geared die stocks or cutters up to 6-in. may be handled. In addition to this, the machine may be used to screw up fittings as a pipe wrench can be held by its driving arms and rotated the same as a pipe die.

The pipe to be threaded is held stationary in a three-jawed, self-centering chuck and the pipe tools are turned by the driving arms. Self-centering universal guides in the rear of the machine assist the chuck in centering long lengths of pipe. An idea of the compactness of this device may be gained from the fact that it is only 18⅛ in. high, 14½ in. wide and 30⅛ in. long.



Threads pipe with ordinary die

This machine is driven by a small, reversible universal motor. It will thread pipe of all sizes up to 2 in. or by the aid of an attachment up to 6 in. It may also be used to make up fittings and couplings.



Starter and cabinet

Across-the-Line Starters Made Easily Accessible

In the accompanying illustration may be seen one of the two new across-the-line starters which have been recently developed and are now being placed on the market by the Westinghouse Electric & Mfg. Co. of East Pittsburgh, Pa. These starters are of the reversing and non-reversing types respectively. They are of compact design and have been made easily accessible for installation and wiring. Two slotted hexagonal screws firmly hold the starter unit in place in a sheet steel cabinet. Thus the starter may be removed as a unit by merely withdrawing these screws with an ordinary screw driver, leaving all the room inside the cabinet free for attaching conduit bushings and drawing in the leads.

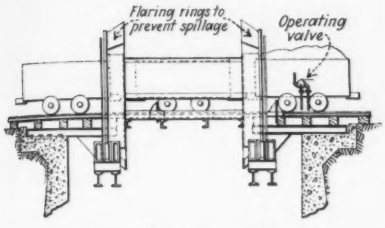
This starter, consisting of a 3-pole contactor with electrical interlock, is completely inclosed and is operated from a push button station that may be located at any convenient point. It thus provides safe control and eliminates damage which might result from tampering by unauthorized parties or by unskilled handling. In addition to this safety precaution, a floating armature type of 3-pole contactor is employed which provides smooth and positive contact. This is quiet in operation and the tips are kept clean by the rolling and wiping action of their closure.

Where operating conditions necessitate the protection of the starter against an accumulation of chips or other foreign matter, a door interlock may be had that makes it impossible to start the motor unless the cabinet door is firmly closed. The non-reversing starters, class 11-160, are applicable for many machine drives where dirt and dust is encountered, such as in textile mills, on machine tools, wood-working machinery, conveyors, blowers, pumps, tipple machinery and the like. The reversing type, class 11-165, embodies the same sturdy and safe construction and the same essential operating characteristics as the non-reversing type, but in addition the mechanical interlock above referred to, making it impossible for the contactors to be closed unless the door is shut. This type has its obvious advantages which need no further comment.

Improvements in Rotary Dump Save Spillage

Rotary car dumps possess many advantages over those of the ordinary crossover or kick-back varieties. In general these are well known to mining men and need no further comment here.

As heretofore constructed dumps of



Improved car dumper with end rings to prevent spillage

this kind possess the drawback that more or less material has been spilled through the end rings; although this could be caught and guided into the hopper it was subject to decided degradation. The improved rotary car dump, shown in the accompanying illustration and manufactured by the Car Dumper Equipment Co., of Chicago, Ill., and Pittsburgh, Pa., is designed to overcome this difficulty.

In this improved dump the end rings are really frustums of hollow cones with flaring ends facing each other. This construction of end rings not only obviates spillage but makes a much more rigid cage or dumper frame. The end rings are cast from alloy steel which is so hard that it cannot be machined, and must be ground to shape. The treads of these end rings are, therefore, ground on a specially designed machine giving an extremely smooth running surface, harder than has been obtained heretofore upon any equipment of this kind. This not only assures long wear but also reduces appreciably the power required to operate the dump. The supporting wheels are also made of the same alloy steel.

Clamp Holding Trolley Wire Supports and Taps Feeder

Demand for some practical device to simplify and cut erection costs in overhead construction has led to the development of a combination feeder-trolley clamp, announced by the Ohio Brass Co., of Mansfield, Ohio. This clamp, arranged for attachment to a standard insulated hanger, supports in a single unit assembly, both the feeder wire and the trolley, the two being firmly gripped at a predetermined distance of separation, by the tightening of one center bolt.

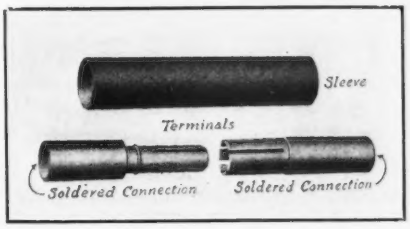
It is estimated that the use of this combination cuts almost in half the material and the work required for the separate installation of these conductors. The clamps themselves act as feeder taps, thus eliminating all necessity for the latter. Flecto iron, a new malleable metal, is used in the manufacture of this combination clamp, making, it is said, a product that is entirely free from brittleness.

A New Plug Fuse

A new non-renewable plug fuse of unique design and attractive appearance has been announced by the Trico Fuse Manufacturing Co., of Milwaukee, Wis. It has a separate porcelain base and body. The base has a long baffle chamber that extends to the inside top of body and holds the mica window in place. Body and base are held together with a heavy brass screw shell. The body is finished in a neat dull black, giving it a molded insulation appearance. Some of its features are: the large rugged knurl around top edge; the clear India mica window; the visible link with amperage stamped on it and the large center contact. This fuse is known as the "Cleartop."

Insulated Connector Affords High Current Capacity

Small diameter, high current capacity, a lack of screws or bolts, the ability to hold against considerable tension before pulling apart, and provision for quick connection and disconnection are



Insulated connector easily made but tenacious

The two terminals are soldered to the cables to be connected. A push forces the two parts together and the ring on the one fitting into an internal groove on the other holds them in place. A rubber sleeve spans the completed connection and insulates it.

highly valuable attributes of any motor lead connector. The new cable connector of the Ohio Brass Co., Mansfield, Ohio, embodies these features.

This connector is intended for use on motor leads and trolley-pole connections of mine locomotives as well as for general use on stationary and portable motors. The terminals, which are of phosphor-bronze, have a double-spring contact. The slotted end of the male connection is compressed by the solid part of the female portion, and likewise the slotted end of the female element grips the solid portion of the male. One excellent detail of the design is the raised ring of boss on the solid portion of the male element. This fits into a corresponding groove in the spring or slotted part of the female element and gives the connector its ability to withstand considerable pull before coming apart.

The cable ends are soldered into the tinned sockets of the connector. In application the cable insulation is trimmed back just far enough so that when the connector is snapped together the distance between the ends of the insulation is slightly less than the length of the tight-fitting rubber sleeve which spans and covers the metal sleeves. In this way a well-insulated joint is attained without the use of tape.

Engine Plant Changes Hands

The motor division of the Wellman-Seaver-Morgan Co. has been acquired through purchase by the Sanderson-Cyclone Drill Co., of Orrville, Ohio. The engine formerly made by this division of the W.-S.-M. company at Akron, Ohio, will hereafter be built and serviced at Orrville. It is a four-cylinder, four-cycle valve-in-head type motor, bore 4¾ in., stroke 6 in., developing 28 hp., at 600 r.p.m. up to 56 hp. at 1,400 r.p.m.

Trade Catalogs

Stoker—Catalog GFD-1, issued by Combustion Engineering Corporation, New York, covers the Green forced draft stoker, recently developed.

Roaster.—The Holt-Dern roaster, intended for blast roasting of ores for hydrometallurgical processes, is described in a new catalog of the Holt-Christensen Process Co., Newhouse Building, Salt Lake City, Utah.

Drills, etc.—Waugh products, for contracting, quarrying, mining and other industries are covered in a new 24-page catalog, Bulletin 150, of the Denver Rock Drill Manufacturing Co.

Capacitators—Bulletin GEA-350 of the General Electric Co., Schenectady, N. Y., cover capacitators.

Grizzly—"The Labor Saver" for March, published by Stephens-Adamson Manufacturing Co., Aurora, Ill., describes the company's S-A "live-roll" non-clogging scalping grizzly.

Thermometers—Catalog No. 92 of the Brown Instrument Co., Philadelphia, Pa., covers the company's newly designed line of resistance thermometers.

Pyrometers—"Instructions for the Installation and Care of Thermo-Electric Pyrometers" is the title of an 80-page book issued by the Brown Instrument Co., of Philadelphia, and covering the following subjects: 1. Theory of Thermo-Electric Pyrometry; 2. Installing Pyrometers; 3. Instruments Installed Ready for Use—Indicators; 4. Instruments Installed Ready for Use—Continuous Recorders. 5. Checking Pyrometer Installations.

Analytical Balances—Improved precision analytical balances of the graduated beam and chainomatic types are described in Bulletin No. 256, issued by Christian Becker, Inc., of New York.

Torsion Balances — Laboratory balances for miscellaneous laboratory service are described in two leaflets issued by the Torsion Balance Co. of 92 Reade St., New York.

Mills, Concentrators — The Gibson counterbalanced rod mill, gyratory mill, rock breaker, concentrator, amalgamator, and portable boiler are described in a catalogue issued by W. W. Gibson, of 112 Market St., San Francisco, Calif.

Pumps, Compressors—The Pennsylvania Pump & Compressor Co. of Easton, Pa., now has ready for distribution two new bulletins as follows: No. 207, describing Pennsylvania multistage centrifugal pumps; and No. 127, describing Pennsylvania direct-connected synchronous motor-driven air compressors.

The Market Report

Firmer Tone in Metal Markets

Copper, Tin, and Zinc Show Some Improvement on Fair Volume of Sales to Consumers

New York, April 14, 1926.—Materially better sentiment is in evidence among copper producers today as a consequence of the issuance of favorable statistics and better prices in London. Zinc likewise is in a better position than a week ago, and lead has picked up in the last two days in sympathy with improvement in prices in London. Tin is fairly active at higher prices, with both consumers and dealers in the market, but silver is weaker. For the first time in many months the New York quotation has fallen below 65c. per ounce.

Copper at 14c.

The issuance of the statistics for March showing a decline of 11,148 tons in stocks of refined copper, and of 5,182 tons in combined stocks of blister and refined, has given producers heart, and most of them are asking 14c. delivered in the East today. The prevailing price until today has been 13.875c. delivered, this figure having been shaded on only one small sale and then by only 2½ points. Some copper sold in the Middle West brought 14c. Today a good tonnage was sold in the Connecticut valleys at 13.95 and 14c. and at high freight-rate points at 14⅛c.

Sales to consumers in Great Britain have been on the basis of 13.85c. f.a.s. New York, and other business has been done abroad at 14.10c. c.i.f., although American producers even before today were holding at higher prices. The statistics show an increase in American output for March as compared with February, but bearing in mind the difference of three days in the length of the month, the rate of production was virtually unchanged. Both export and domestic shipments showed a material increase in March. Exports totaled 44,373 tons, a gain of 8,909 tons, whereas the total of domestic deliveries was 88,573 tons, or an increase of 18,167 tons.

Daily Prices of Metals

April	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
8	13.625	61 50	62.50	8.00	7.80	7.00
9	13.625	61.25	62.25	8.00	7.80	6.95
10	13.625	61.125	62.125	8.00	7 70	7.05
12	13.65	61 75	62.75	8.00	7.60@7.70	7.10
13	13.70	62.75	63.75	8.00	7.75	7 15
14	13.70@13.875	63.00	64.00	8.00	7.75	7.15
Av.	13.669	61.896	62.896	8.00	7.742	7 067

The prices correspond to the following quotations for copper delivered: April 8th, 9th and 10th, 13.875; 12th, 13.90c.; 13th, 13.95c.; 14th, 13.95@14.125c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
8	57	57⅞	64½	279	267	29¼	29⅞	32 5/16	32 15/16
9	56¾	57⅝	64¼	279½	268	28¼	28⅞	32⅜	32 15/16
12	56¾	57⅝	64	280	269	28½	29 1/16	32 1/16	32 9/16
13	56⅞	57¾	64¼	284¼	270¼	29⅛	29⅜	32 9/16	33⅛
14	57⅛	58½	64½	286	273¼	29⅛	29 9/16	32 13/16	33¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

April	Sterling Exchange "Checks"	Silver		Gold London	April	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
8	4 85¾	65⅜	30 1/16	84s 11½d	12	4 85¾	64⅜	29 13/16	84s 11½d
9	4 85¾	65¼	30	84s 11½d	13	4 85⅝	64⅜	29⅞	84s 11½d
10	4 85¾	65	29 15/16	.....	14	4 85 9/16	64⅝	29⅞	84s 11½d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

Lead Holding Steady

A slight sag occurred in the lead market from Friday to Monday, but it has been offset by the improved tone of the London market in the last two or three days. A small tonnage of lead was sold as low as 7.90c., New York, and 7.60c., St. Louis, but the metal offered at these levels was quickly disposed of, and the market seems firm today at 8c., New York, and 7¾c., St. Louis. Occasional carloads of spot lead have been sold during the week at about 8.10c., New York, and slight premiums have also been obtained in the East on chemical lead from the Middle West. On the other hand, desilverized lead is slightly scarcer than chemical in the Middle West. There has been some realignment among the sellers, one large interest that was selling fairly freely two or three weeks ago now offering to sell very unwillingly, whereas another large producer is anxious for all the business it can find, especially for May, though offering April shipment too. Spot lead is rather scarce, but consumers seem well provided for with respect to their immediate requirements, and report little or no change in their business.

Zinc Back to 7.15c. per Pound

A good volume of business on the part of consumers developed when zinc reached 7c. per lb. at St. Louis, galvanizers and brass founders both being in the market. Offerings at this level apparently were taken up, and since Monday 10 to 15 points more has been realized, though business has not

been brisk. Though the statistics of the American Zinc Institute shown below indicate an increase in stocks of 220 tons, this was much below what had been expected by many observers. It had been supposed that domestic deliveries had been curtailed; on the contrary they were unusually large, being 473 tons in excess of the high previous record of January, 1926. A large proportion of the domestic deliveries doubtless were of Brass Special and High Grade quality. High Grade is available in New York at 8.625c. per pound, although one producer is asking 8.75c. The statistics are as shown below in tons of 2,000 lb.

Stock, March 1	20,341
Produced,	54,411
	74,752
Shipped,	54,191
Stock, March 31	20,561
Shipped from plant for export	2,576
Stored for customers	930
Retorts operating March 31	89,497

Tin Position Strong

Buying of tin was rather active at the lower level of prices, between 62 and 63c. obtaining early in the week, though much of it was confined to dealers. Consumers are providing themselves well for their May and early June requirements, evidently sensing a continued high premium for spot and prompt tin, but are showing little interest in July deliveries, even at the marked concessions of 2 to 2½c. from the prices asked for prompt. The reaction upward in London has brought the New York market to about 64c. for prompt Straits today.

Exchanges Steady

Francs are a little lower than last week, but the foreign exchanges have generally held steady. Closing cable quotations on Tuesday, April 13, were as follows: francs, 3.445c.; lire, 4.025c.; and marks, 23.81c. Canadian dollars, 3/32 per cent premium.

Silver Falls to 64 5/8c.

With the exception of a short-lived rally on April 8, caused by Indian bazaar buying, silver has continued its downward trend. The New York market resisted the decline for a time, but selling orders appeared on April 14, with buyers at lower levels only, and as a result the quotation for that day established another new low price for the year at 64⅝c. The London spot quotation of 29 13/16d. on April 12 was also the lowest rate for 1926.

Mexican Dollars: April 8th, 50⅛c.; 9th, 50c.; 10th, 49⅞c.; 12th and 13th, 49¾c.; 14th, 49⅝c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £118 per long ton.

Antimony—Per pound, duty paid, New York: Chinese brands, spot, 18@17.50c. May arrival, 17.25@16.50c. Cookson's "C" grade, spot, 22c. Market very quiet and spot prices mostly nominal.

Bismuth—$2.70@$2.75 per lb., in ton lots. London, 10s.

Cadmium—60c. per lb. Market slow. London, 1s. 9d. for Australian metal.

Iridium—$225 per oz. for 98@99 per cent. Nominal. London, £70@£75 for 99.5 per cent.

Nickel—Ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent); London, £170@£175 per long ton.

Osmium—$85@$90 per ounce; London, £19@£22.

Palladium—$77@$81 per oz. Crude, $55@$60 per oz. London, £14@£16¼, nominal.

Platinum — $112 per ounce refined officially quoted. Sales also at $105@$107. Crude, $103. London, £22½@£23½ for refined; crude, £21@£22.

Quicksilver—Per 75-lb. flask: $88.50@$89 for spot and forward. San Francisco, $89.33. London, £14⅝.

Rhodium—$75@$85 per oz.; London, £14@£17. Nominal.

Ruthenium — $75@$85 per ounce; London, £13@£16.

The prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Palladium, Radium, Rhodium, Selenium, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of April 3.

Metallic Ores

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $11.50@$12; Western scheelite, $12@$12.75. Domestic demand very light, and prices largely nominal.

Vanadium Ore—Containing 4 to 8 per cent V_2O_5, 30@35c. per pound of V_2O_5 f.o.b. Montrose, Colo.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 60@65c. per pound V_2O_5, duty paid, seaboard.

Chrome Ore, Manganese Ore, Molybdenum, Tantalum, and Iron Ores are unchanged from quotations in the April 3 issue.

Zinc Blende Unchanged—Lead Ore Lower

Joplin, Mo., April 10, 1926

Zinc Blende	Ton
High	$53.10
Premium blende, basis 60 per cent zinc	$48.00@49.00
Prime Western, basis 60 per cent zinc	$47.00
Fines and slimes, 60 per cent zinc	$46.00@44.00
Average settling price, all zinc	47.98
Galena	
High	107.60
Basis 80 per cent lead	95.00
Average settling price, all lead	104.46

Shipments for the week: Blende, 14,468; lead, 1,974 tons. Value all ores the week, $890,360.

Sellers, who have been slow to dispose of their zinc the last two weeks, today freely accepted current offerings on 20,160 tons, four-fifths as much as during the two preceding weeks. Export buyers withdrew from the market this week, indicating a weakness the significance of which sellers were quick to grasp. Production dropped more than 1,000 tons this week, with additional mills closed temporarily.

Platteville, Wis., April 6, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$49.50
Lead Ore	
Lead, basis 80 per cent lead	$95.00

Shipments for the week: Blende, 946 tons; lead, none. Shipments for the year: Blende, 14,066; lead, 362 tons. Shipments for the week to separating plants, 1,768 tons blende.

Non-Metallic Minerals

Amblygonite, Andalusite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the April 3 issue.

Mineral Products

Arsenious Oxide (White arsenic)—3¼@3½c. per lb. Small sales. London, £14@£15 per long ton.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the April 3 issue.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $88@$90 per gross ton.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from prices in the April 3 issue.

Metal Products

Rolled Copper — Sheets, 22½c.; wire, base price, 16c. per lb.

Zinc Sheets — 11.75c. per lb., f.o.b. works.

Lead Sheets, Nickel Silver, and Yellow Metal are unchanged from prices in the April 3 issue.

Refractories

Chrome Brick, Firebrick, Magnesite Brick, Silica Brick, and Zirkite are unchanged from prices in the April 3 issue.

Steel, Pig Iron, and Coke Steady and Dull

Pittsburgh, April 13, 1926

Steel ingot production in March was 4,491,689 gross tons, making a daily rate of 166,686 tons, 4.9 per cent above the February rate and 2.8 per cent above the record, made in March, 1924.

Steel prices are not quotably changed, but are naturally under considerable pressure in two or three lines, sheets being conspicuously one of these.

Pig Iron.—Market activity has not increased by last week's price declines of $1.50 in foundry and $1 in basic and bessemer. Bessemer, $20; basic, $19; foundry, $19, f.o.b. Valley furnaces.

Connellsville Coke.—There is no contract business and the spot market is dull, with prices a shade easier at $3@$3.15 for furnace and $4.25@$4.75 for foundry.

Company Reports

United States S., R. & M. Co.'s Earnings $1,000,000 Above 1924

Gross earnings of the United States Smelting, Refining & Mining Co. and affiliated companies were $7,188,612.36 in 1925, compared with $6,172,412.73 in 1924.

Consolidated Profit-and-Loss Account

Earnings, after charging cost of production, selling expenses, reserves for federal taxes		$7,989,994.70
Less interest on funded debt		801,382.34
Total		$7,188,612.36
Less reserves for depreciation, depletion and amortization		2,785,665.35
Profits for year 1925		$4,402,947.01
Surplus as per previous balance sheet		17,317,516.97
Add profits for year 1925 as above		4,402,947.01
		$21,720,463.98
Less additional reserves for depreciation, depletion and amortization	$1,500,000.00	
Dividends	2,799,459.37	4,299,459.37
Surplus as per balance sheet		$17,421,004.61

The additions to the property and investment account have been as follows:

Investments in Alaska	$2,857,244.17
Additions to buildings, plants and equipment	1,362,712.48
Investments in mining properties, mining securities and miscellaneous additions to mines	326,111.20
	$4,546,067.85
Less sales of property and other credits	305,551.74
Additions during the year	$4,240,516.11

The investments in Alaska include additional investments in placer mining claims and equipment, exploration and development of the gold dredging properties in the Nome and Fairbanks districts of Alaska; also, acquisition of all of the outstanding minority interests in these projects, which are now solely owned by the company.

Additions to buildings, plants, and equipment principally represent construction of the flotation mill at Midvale. Other items of lesser importance include additional furnace equipment at Midvale.

Current assets are $24,067,979.41, against current liabilities of $13,358,560.71.

The record output at the Mexican properties during 1924 was again substantially achieved during the year, the mills treating an average of 100,194 tons per month as compared with 100,197 tons last year. The grade was maintained and there was satisfactory improvement in the metallurgy. Prices realized for silver were better than in the previous year, but this was offset by increased production costs.

Production at Bingham, including that of the Niagara Mining Co., for the year amounts to 209,471 tons, an increase of 36,961 tons over last year. The concentrator at Midvale handled 172,510 tons lead-zinc ore during the year. The lead smelter treated 267,178 tons of marginal ore, producing 50,326 tons of bullion, an increase of 10,099 tons over the previous year. It is expected that the new flotation mill will be in operation early in 1926. During the year it became apparent that the size of the mill should be increased to a capacity of 750 tons per day.

The Sunnyside mine and mill, in Colorado, operated continuously; 273,895 tons of ore was treated, compared with 220,245 tons last year.

Lorrain Trout Lake Earned $60,327

The report of M. F. Fairlie, resident manager for the Lorrain Trout Lake Mines, Ltd., of Ontario, Canada, says that shipments of mill ore were made at the rate of approximately 50 tons per day. The total tonnage of this material for the year was 12,813 tons with an average assay of 22.26 oz. and silver content of 285,173 oz. In addition, 124.97 tons of high-grade ore containing 187,582 oz. was sacked and shipped direct to the smelter. The total silver production for the year was 436,302 oz., compared with 263,912 oz. for the previous year.

Included with "Mining Costs" in the table given below is the total cost of sinking No. 2 Shaft. The unit costs are based on a production of 12,938 tons of ore and 436,302 oz. of silver.

	Total Cost	Per Ton	Per Ounce in Cents
Mining costs	$131,898.58	$10.19	30.23
Freight and realization (including sampling, selling and smelter charges)	33,083.76	2.57	7.58
Milling and reduction	44,845.33	3.46	10.28
Administration and general	11,027.45	.85	2.53
	$220,855.12	$17.07	50.62
Head office	23,089.39	1.78	5.29
Written off plant	989.88	.08	0.23
Reserve for taxes	5,953.90	.46	1.36
	$250,888.29	$19.39	57.50

Income and Profit

	Total	Cost per Ton	Cost per Ounce Silver
By value of production	$307,021.88	$23.73	$0.7037
Interest	4,193.40	.32	0.0096
Gross income	$311,215.28	$24.05	0.7133
To total cost	250,888.29	19.39	0.5750
Profit	$60,326.99	$4.66	$0.1383

Eagle & Blue Bell Mining Co.

Below is the income account for the year ended Dec. 31, 1925, of the Eagle & Blue Bell Mining Co., operating in the Tintic district in Utah.

Gross Income from Operations

Ore shipments	$237,029.47	
Royalties	52,438.86	
Rents	118.56	
Commissions	2,220.64	
Miscellaneous	5,086.34	$296,893.87
Operating Expenses		
Smelting, freight, sampling and assaying	$106,189.98	
Mine operations	48,597.63	
Management, office, legal expenses, federal taxes	16,693.15	
Insurance, miscellaneous taxes, general expenses	16,506.16	187,986.92
Net earnings and revenue		$108,906.95
Mine Development		
Prospecting and development		35,505.34
Net operating gain		$73,401.61
Other income		
Interest		2,429.68
Net income		$75,831.29
Surplus Account		
Surplus, Dec. 31, 1924	$442,053.05	
Net income (see income statement)	75,831.29	$517,884.34
Less		
Construction and equipment depreciation	$8,602.55	
Mine depletion	30,827.68	
Miscellaneous adjustments	193,636.78	
Dividends paid—1925	89,314.60	322,381.61
Surplus, Dec. 31, 1925		$195,502.73

Alaska Juneau Lost $10,835 in 1925

During 1925, the Alaska Juneau Gold Mining Co. recovered $2,184,384.08 in gold, silver, and lead, at an operating and marketing cost of $1,826,903.46, leaving an operating surplus of $357,480.62, which was increased by other income to $357,631.62. Interest charges totaled $191,743.25, which, with deductions of $176,724.33 for main plant depreciation, left a net loss, before depletion, of $10,835.96, increasing the deficit in surplus to $995,358.81. Capital expenditures for property, mine development, construction, and equipment totaled $237,300.51 during 1925.

The average daily tonnage was increased from 8,476 tons in 1924 to 9,618 tons in 1925 by an expenditure of $237,300 of operating earnings in enlarging the milling plant to a capacity of 10,500 tons per day. The remainder of the operating earnings for 1925, amounting to $120,331, was expended on the Ebner mine, an increase in warehouse inventories, and as interest payments on portions of the indebtedness. F. W. Bradley, president, states that the increase in capacity gained during 1925 was not as great as expected, because of insufficient earnings due to a decrease in the grade of the ore milled, and also because the en-

largement work is now much more demanding, having spread from the mill to the broad front of all shop, tramming, and mining departments; but this work will be continued and extended as rapidly as earnings permit until the over-all capacity of all departments has been coordinated and increased to a total of 14,000 tons per day.

The present expectation is that operating profits will average about $100,000 per month as soon as an over-all capacity of 12,000 tons per day has been reached.

At this date the company has bonds outstanding in the amount of $1,894,000, with an additional indebtedness of unpresented bond coupons and open accounts payable that exceeds the cash and other liquid assets by approximately $600,000.

Operating Loss for Isle Royale

The following data are contained in the annual report of the Isle Royale Copper Co. covering its operations in Michigan for the year ended Dec. 31, 1925:

Production and Costs

Copper production for the year, pounds			9,543,000
		Cents per Pound	
Mining		9.63	$919,329.78
Smelting		1.05	100,095.00
Boston office and mine and corporation taxes		1.06	101,223.68
Selling and delivery		.40	38,236.48
Depreciation and depletion		3.51	334,760.08
Production cost of	9,543,000 lb. at	15.65	$1,493,645.02
On hand Jan. 1, 1925	3,250,908 lb. at	15.00	487,636.22
Selling and delivery of same			13,025.60
	12,793,908 lb.		$1,994,306.84
Sold in year	11,000,954 lb.		1,713,678.40
On hand Dec. 31, 1925	1,792,954 lb. at	15.65	$280,628.44

Earnings Statement

		Cents per Pound	
Received for copper sold	11,000,954 lb. at	14.22	$1,564,466.96
Cost of same	at	15.58	1,713,678.40
Loss		1.36	$149,211.44
Miscellaneous receipts			
Interest		$20,607.09	
Miscellaneous expenses		4,278.03	16,329.06
Loss for year			$132,882.38

Changes in Net Current Assets

Balance of current assets Jan. 1, 1925			$1,228,572.50
Loss for year		$132,882.38	
Less depreciation and depletion reserves		334,760.08	
		$201,677.70	
Capital assets			
Plant increased—new construction	$9,541.07		
Dividend paid Dec. 15, 1925	150,000.00	159,541.07	
Net increase in current assets			42,336.63
Balance of current assets Dec. 31, 1925			$1,270,909.13

Rio Tinto Profit £1,381,417 in 1925

Operations at the mines of the Rio Tinto Co., Ltd., in Spain, continued uninterruptedly throughout 1925 and the output of mineral and production of copper were satisfactory. The price of copper, however, was disappointing, the average of standard for the year being £1 4s. 6d. per ton less than that for 1924. On the other hand, there was a decrease in the cost of production.

Revenue Account for 1925

Debit	£	s.	d.	£	s.	d.
Income tax and dues on shares in France, and Spanish taxes not otherwise charged	124,752	9	4			
Expenses of administration, salaries, rents, and general charges in London, Spain, and elsewhere	124,352	15	6			
Hospitals, medical assistance, workingmen's pensions and welfare	41,881	2	11			
				290,986	7	9
Interest on Spanish 6 per cent Peseta Loan				23,659	8	9
Allowance to directors, in accordance with the articles of association, viz., 1 per cent on profits over 10 per cent				6,840	6	2
Plant and outlay written down and written off, including railways				105,188	3	9
Staff Pension Fund				3,762	19	0
Balance carried to balance sheet				1,499,903	7	6
				£1,930,340	12	11

Credit	£	s.	d.	£	s.	d.
Balance for 1924, as per previous account	1,491,463	4	7			
Deduct dividends paid for 1924	1,018,750	0	0			
Balance brought down from 1924				472,713	4	7
Profit on sale of produce, 1925,						
In Spain	100,075	7	4			
Elsewhere	1,281,342	5	2			
				1,381,417	12	6
Interest and discount account				76,191	0	10
Transfer and other fees				18	15	0
				£1,930,340	12	11

Tennessee Copper & Chemical Corporation

The report of J. N. Houser, general manager of mining operations for the Tennessee Copper & Chemical Corporations, shows the following results for 1925:

Ore Production and Costs

	Burra Burra	London	Eureka	All Mines
Tonnage	386,016	92,792	16,723	495,531
Mining per ton	$1.058	$1.618	$1.177	$1.166
Development per ton	$0.290	$0.114	$0.094	$0.251
Total cost per ton	$1.348	$1.732	$1.271	$1.417

Estimated Ore Reserves

	Burra Burra	London	Eureka	Polk Co.	All Mines
Available tonnage	3,551,114	50,094	2,095,539	55,550	5,752,297
Broken ore in stopes (included in above)	113,000	6,000	.....	5,000	124,000

Converting cost for the year was $0.00786 per pound of fine copper.

The cost of fine copper (13,625,707 lb.) based on converter production was $0.11784 per pound, subdivided as follows:

Mining expense	$0.05330
Railway expense	0.00179
Treating expense (smelting and milling)	0.04143
Converting expense	0.00786
General expense	0.01346
Total operating cost per pound of fine copper from Tennessee ores (exclusive of New York charges)	$0.11784

The following is a summary of results at the flotation plant for the year:

Copper Flotation

Ore milled, tons		
London mine	90,585	
Burra Burra mine	76,878	
Eureka mine	2,575	
Total tons		170,038
Average heads, per cent copper		1.43
Concentrate produced (dry weight), tons		21,886
Average grade concentrate produced, per cent copper		9.83
Ratio of concentration		7.8 : 1
Actual recovery, per cent		88.3
Cost per ton of ore milled		$0.756

Material smelted in blast furnaces during the year was as follows:

	Tons
Tennessee Copper Co. ore	343,320
Bed matte	1,185
Converter slag	14,625
Blast furnace slag	2,050
Quartz	46,060
Total	407,240
Coke	16,516

Smelting cost for the year was $1.18255 per ton ore smelted.

Consolidated Profit-and-Loss Account—1925

Operating	$7,169,355.43
Miscellaneous expenses	303,802.85
Profit carried down	1,213,364.74
	$8,686,523.02
Interest on bonds	$53,789.27
Reserve for depreciation	339,328.37
Transfer to surplus	820,247.10
	$1,213,364.74
Sales	$8,242,790.46
Balance of interest and miscellaneous income	443,732.56
	$8,686,523.02
Profit brought down	$1,213,364.74
	$1,213,364.74

Current assets as shown in the balance sheet total $8,892,667, against current liabilities of $571,640.

Mining Stocks—Week Ended April 10, 1926

Stock	Exch.	High	Low	Last	Last	Div.
COPPER						
Anaconda	New York	44⅜	43½	43⅞	Ap.17, My.24	0.75
Arcadian Consol.	Boston	*45	*27	*45		
Ariz. Com'l	Boston	10⅛	9¼	10	Jy.21, Jy. 31	SA0.50
Calaveras	N. Y. Curb	2⅛	2⅛	2⅛		
Calumet & Arizona	New York	58¼	57⅜	57⅜	Mr.5, Mr.21	QX1.50
Calumet & Hecla	Boston	15	14	14⅜	Nov 30, De.15	Q 0.50
Cerro de Pasco	New York	63	61½	62	Ap. 15, My. 1,	Q1.00
Chile Copper	New York	32⅜	32	32⅛	Ma. 3, Ma. 29,	Q 0.62½
Chino	New York	20½	20	20½	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	1⅛	1⅛	1⅛		
Copper Range	Boston	16⅜	16⅛	16⅛	May, 1925	1.00
Crystal Copper	Boston Curb	*48	*40	*45		
East Butte	Boston	3½	3⅛	3⅛	Dec., 1919	0.50
First National	Boston Curb			*15	Feb., 1919	0.15
Franklin	Boston	*50	*50	*50		
Granby Consol.	New York	18⅛	17⅜	18	May, 1919	1.25
Greene-Cananea	New York	10¼	10⅛	10⅛	Nov., 1920	0.50
Hancock	Boston	*80	*80	*80		
Howe Sound	New York	33⅜	32⅛	33	Ap. 1, Ap.15	0.75
Inspiration Consl.	New York	22⅞	22⅛	22⅛	Mar.18, Ap.5,	Q0.50
Iron Cap	Boston Curb			3½	May, 1923	0.15
Isle Royale	Boston	11	11	11	No. 30, De.5	1.00
Jerome Verde Dev.	N. Y. Curb	*90	*70	*72		
Kennecott	New York	52½	52	52	Ma.5, Ap.15	Q 1.00
Lake Copper	Boston	1	*90	1	June, 1925	0.50
Magma Copper	New York	39	36½	37⅛	Mh.31, Ap.15,	Q 0.75
Mason Valley	N. Y. Curb	2	2	2		
Mass Consolidated	Boston			*40	Nov., 1917	1.00
Miami Copper	New York	12⅛	11⅝	12	My.1, My.15	Q 0.25
Mohawk	Boston	31⅛	30⅛	30⅛	Jan. 30, Ma.1	Q1.00
Mother Lode Coa.	New York	6½	6⅛	6⅛	De. 11, De. 31	0.37½
Nevada Consol.	New York	12⅝	12⅛	12⅛	Mh.18, Mh.31	Q0.25
New Cornelia	Boston	20	19⅛	20	Fe.5, Fe.23	Q 0.30
North Butte	Boston	2⅞	2⅛	2⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*60	*50	*53	No. 14, De. 2	0.05
Old Dominion	Boston	15⅞	15⅛	15⅛	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†125	†120		Mar.20, Apr.2	Q1.00
Quincy	Boston	20⅛	19⅜	20	Mar., 1920	1.00
Ray Consolidated	New York	12¾	11½	12⅜	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb			11⅞		
St. Mary's Min. Ld.	Boston	31⅛	30⅛	30⅛	May, 1925	3.00
Seneca Copper	New York	6	5	6		
Shannon	Boston	*50	*50	*50	Nov., 1917	0.25
Superior & Boston	Boston	*62	*60	*62		
Tenn. C. & C.	New York	12⅜	11⅞	12⅛	Fe.27, Ma.15,	Q 0.25
United Verde Ex.	N. Y. Curb	27⅛	27⅛	27⅛	Ap.6, My.1,	0.75
Utah Copper	New York			93	Mh.18, Mh.31	Q1.25
Utah Metal & T.	Boston	2⅛	1⅞	2	Dec., 1917	0.30
Victoria	Boston			*50		
Walker Mining	Salt Lake	1.05	1.00	1.00		
NICKEL-COPPER						
Internat. Nickel	New York	36⅜	34⅝	35	My.11, My.31,	Q0.50
Internat. Nickel, pfd.	New York			103	Ap.15, My.1,	Q 1.50
LEAD						
Gladstone M. M. Co.	Spokane	*36	*34½	*34½	Ja. 1, Ja. 10	M 0.01
National Lead	New York	150	146½	148	Ma.12, Ma.31	Q2.00
National Lead pfd.	New York	117	116	117	Aug.21, Se.15	1.75
St. Joseph Lead	New York	40⅜	38⅛	39	Je.10, Je. 21	QX0.75
ZINC						
Am. Z. L. & S.	New York	8	7⅛	7⅝	May., 1920	1.00
Am. Z. L. & S, pfd.	New York	31	30¼	31	Nov., 1920	1.50
Butte C. & Z	New York	5⅛	5	5	De.10, De.24	0.50
Butte & Superior	New York	12⅞	12⅛	12⅛	Ma.15, Ma.31	Q0.50
Callahan Zn-Ld	New York	1⅜	1⅛	1⅜	Dec., 1920	0.50
Eagle Picher	Cincinnati	30	29	30	My. 15, Jn.1	0.40
Eagle Picher, pfd.	Cincinnati			110	Mh.31, Ap.15	Q 1.50
New Jersey Zn.	N. Y. Curb			208	Ap.20, My.10	Q 2.00
United Zinc	N. Y. Curb			*70		
Yellow Pine	Los Angeles	*25	*25	*25	De.8, De.18	Q 0.04
GOLD						
Alaska Juneau	New York	1⅞	1⅝	1⅝		
Argonaut	Toronto	*31	*28⅜	*30½		
Barry-Hollinger	Toronto	*40	*39	*40		
Carson Hill	Boston			*30		
Consol. W. Dome L.	Toronto	*20½	*18⅝	*20½		
Cresson Consol. G.	N. Y. Curb	2⅜	2⅛	2⅛	Mh.31, Ap.10	0.10
Crown Reserve	Toronto	*17	*16	*16½	Jan., 1917	0.05
Dome Mines	New York	17½	15⅞	16⅝	Mh.31, Ap.20,	Q 0.50
Golden Center	N. Y. Curb	1⅛	1⅛	1⅛		
Golden Cycle	Colo. Springs	†*1.51	†1.50		No. 30, Dec. 10	Q 0.03
Hollinger Consol.	Toronto	18.25	17 93	18.25	Ap. 6, Ap. 22,	0.08
Homestake Mining	New York	55	54	54	Ap. 20, Ap. 26	M 0.50
Kirkland Lake	Toronto	1.23	*99	1.23		
Lake Shore	Toronto	10.45	10.10	10.40	Ma.1, Ma.15	Q 0.10
McIntyre-Porcupine	New York	25	24	25	Fe.1, Ma.7	0.05
Newray	Toronto	*36	*35	*35		
Night Hawk Pen	Toronto	*6	*5½	*5½		
Noranda	N. Y. Curb	14⅞	13¾	14⅞		
Portland	Colo. Springs	†*56†	*50		Apr.6, Apr.15	0.02
Rand Mines	New York			34⅜	Fe.16, Fe.26	1.52
Teck-Hughes	Toronto	3.45	3.09	3.45	Ja. 15, Fe. 1	0.05
Tom Reed	Los Angeles	*72½	*70	*72½	Ma.10 Ma.20	0.02
Tough-Oakes	Toronto	*48	*44	*45		
United Eastern	N. Y. Curb	*43	*43	*43	July, 1924	0.05
Vipond Cons.	Toronto	1.68	1.60	1.67		
Wright-Hargreaves	Toronto	8.25	7.90	8.05	Mh.15, Ap.1	QX0.07½
Yukon-Alaska Trust	N. Y. Curb	21½	20½	21½		
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	19	18½	18½		
Con. Cortez	N. Y. Curb			*6		
Con. Virginia	San Francisco	*12½	*8½	*10½		
Continental Mines	N. Y. Curb			*45		
Dolores Esperanza	N. Y. Curb			*50	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅛	2⅛	2⅛	Mh.19, Apr.3	Q 0.08
Tonopah Belmont	N. Y. Curb	3¾	3¼	3½	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	*70	*60	*60	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	5⅝	5½	5⅝	Ap.7, Ap.21	Q 0.07½
Unity Gold	N. Y. Curb			*20		
West End Consol.	N. Y. Curb			*25	Mar., 1923	0.05
Yukon Gold	N. Y. Curb			*45	June, 1918	0.02

Stock	Exch.	High	Low	Last	Last	Div.
SILVER						
Alvarado	N. Y. Curb			1	Oct., 1920	0.50
Beaver Consol	Toronto	*82	*69	*82	May. 1920	0.03
Castle-Trethewey	Toronto	1 63	1 57	1.59		
Coniagas	Toronto	4.05	4.00	4.05	May, 1924	0.12½
Keeley	Toronto	1.64	1.59	1.64	Ma. 1, Ma.15	X0.12
Kerr Lake	N. Y. Curb	1	1	1	Ap.1, Ap.15	0.12½
La Rose	Toronto	*17⅛	*16	*17	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto			*85	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav.	Toronto	*18	*17	*17	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.71	3.53	3.65	Ja. 16, Ja.30	0.12½
Nipissing	N. Y. Curb	6	6	6	Mh.31, Ap.20,	Q0.15
Temiskaming	Toronto			*13	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	9	8½	8⅝	Mh.8, Ap.5,	Q X0.25
Alta Merger	Salt Lake	†*3½	†*1			
Bingham Mines	Boston	44¼	41½	43	Ma.20, Ma.31	Q 1.00
Cardiff M. & M.	Salt Lake			*55	De.16, No.18	0.10
Chief Consol.	Salt Lake	3.40	3.30	3.30	Fe. 1,	0.10
Emma Silver	Salt Lake	†*2	†*1½			
Erupcion	Boston Curb	1⅜	1⅛	1⅛	Mh.18, Ap.5,	X 0.10
Federal M. & S.	New York	90	86	86		
Federal M. & S., pfd.	New York	77	72½	76⅞	No.25, De.15	Q 1.75
Hawthorne Mines	N. Y. Curb	*22	*12	*16		
Hecla Mining	N. Y. Curb	17¾	17½	17⅝	Fe.15, Ma.15	Q 0.50
Iron King Mining	Salt Lake			34		
Keystone Mining	Salt Lake	*49	*49	*49	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*15⅜	*15⅜	*15⅜		
Mammoth Mining	Salt Lake	2.85	2.82½	2.82½	Mar.24, Apr. 1	0.10
Marsh Mines	Spokane	*5⅝	*4⅜	*5	Se.15, Oc.1	0.15
Ontario Silver	New York			10		
Park Utah	Salt Lake	6.75	6.50	6.50	Mh.15, Ap.1	0.15
Prince Cons	Salt Lake	*4¾	*3	*4¾		
Silver King Coal	Salt Lake	7.75	7.55	7.55	Mh.20, Ap.1,	Q 0.25
Silversmith	Spokane	*46½	*45	*45	Apr. 1, Apr.10	0.02
Tamarack-Custer	Spokane	*54	*49	*49	Sept., 1924	0.25
Tintic Standard	Salt Lake	12.50	12.12½	12.12½	Mh.1, Mh.20,	QX0.40
Utah-Apex	Boston	9⅞	9⅛	9⅛	Apr. 9, Apr. 15	0.25
Western Utah Copper	N. Y. Curb			*8		
IRON						
Bethlehem Steel	New York	42⅞	39½	39½	July, 1924	1.25
Colorado Fuel & Iron	New York	31½	29½	29½	May, 1921	0.75
Gt. North'n Iron Ore	New York	24⅜	22⅝	23	De. 4, De. 28,	0.75
Inland Steel	New York	39⅜	37⅝	37⅝	Fe.15, Ma.1	Q 0.62½
Mesabi Iron	N. Y. Curb	1⅜	1⅜	1⅜		
Replogle Steel	New York	10⅜	10	10⅛		
Republic I. & S.	New York	52¾	48⅛	48⅝	May, 1921	1.50
Republic I. & S. pfd.	New York	93½	92⅝	93	Ma.15, Ap.1,	Q 1.75
Sloss-Sheffield S. & I.	New York	114⅝	107	107	Ma.10, Ma.20	Q1.50
Sloss-Shef. S.&I. pfd.	New York			102	Ma.20, Ap.1,	Q1.75
U. S. Steel	New York	123⅜	119⅞	120⅛	Fe.27, Ma.3	QX1.75
U. S. Steel pfd	New York	126⅞	125⅜	126	Fe. 3, Fe. 27,	Q 1.75
Virginia I. C. & C.	New York			49½	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York			73½	De.15, Ja.2,	2.50
ALUMINUM						
Alum. Co. of Amer.	Open Market	65	65	65		
Alum. Co. of Amer.	Pfd.		†100¼	†199⅜		
VANADIUM						
Vanadium Corp.	New York	37½	31	35⅜	Fe.1, Fe.15,	Q 0.50
ASBESTOS						
Asbestos Corp.	Montreal			89	De.31, Ja.15	Q 1.50
Asbestos Corp., pfd.	Montreal			113	De.31, Ja.15,	Q 1.50
SULPHUR						
Freeport Texas	New York	24⅜	24	23½	Nov., 1919	1.00
Texas Gulf	New York	133⅜	130	131	Ma.1, Ma.15,	Q 2.50
DIAMONDS						
De Beers Consol.	New York			28½	Ja.26, Fe.2	0.23
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	4½	4⅛	4⅛		
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	51¼	50⅛	50⅛	Fe.18, Ma. 1,	Q 1.00
Amer. Metal pfd.	New York			115	Fe. 19, Ma. 1,	Q 1.75
Amer. Sm. & Ref.	New York	120	117	117⅞	Ap.16, My.1,	Q 1.75
Amer. Sm.&Ref.pfd.	New York	114	113	113⅞	My.7, Je.1,	Q 1.75
Consol. M. & S.	N. Y. Curb			208	De.31, Ja.15	0.75
Federated Metals	N. Y. Curb	17	17	17		
Newmont Mining	N. Y. Curb			49⅜	Mar.31, Apr.15,	0.60
Southwest Metals	N. Y. Curb			2		
U. S. Sm. R. & M.	New York	43½	41	41	Ap.8, Ap 15,	Q 0.87½
U. S. Sm. R.&M.pfd.	New York	48⅛	47⅜	47⅜	Ap 8, Ap.15,	Q 0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED MARCH 29, 1926

Name	High	Low	Last	Last Dividend Date	Amount
Aramayo Mines (25 frs.)	82/6	78/1½	80/—	Feb. 1926	5 p.c.†
British Platinum (£1)	6/3	5/1½	5/—	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	16/3	15/9	16/—	Feb. 1926	6 annas*
Bwana M'Kubwa (5s)	6/9	6/3	6/6		
Camp Bird (£1)	5/4½	5/3	5/4½		
El Oro (£1)	6/9	6/4½	6/9	Nov. 1924	2½ p.c.*
Esperanza (10s)	1/6	1/4½	1/6		
Frontino & Bolivia (£1)	8/6	8/—	8/6	Jan. 1926	1½ p.c.
Mexican Corpn. (£1)	19/—	18/4½	18/9		
Mexico Mines of El Oro (£1)	32/6	31/3	32/6	Dec. 1925	12½ p.c.*
Oroville Dredging (£1)	3/9	3/4½	3/9	Dec. 1923	3½ p.c.
Ouro Preto (£1)	2/6	2/—	2/6	May 1925	2½ p.c.
Rhodesian Congo Border	115/7½	110/7½	115/—		
St. John del Rey (£1)	8/9	6/9	7/—	June 1925	6½ p.c.
San Francisco Mines (10s)	29/1½	28/6	28/9	Jan. 1926	22½ p.c.
Santa Gertrudis (£1)	21/—	20/—	20/6	July 1920	5 p.c.
Selukwe (2s. 6d.)	11/—	9/—	10/9	April 1917	6¼ p.c.
S. Amer. Copper (2s.)	5/10½	4/9	5/—	Nov. 1917	75 p.c.
Tanganyika (£1)	43/9	38/9	40/—	Sept. 1925	5 p.c.
Tomboy (£1)	3/3	3/—	3/3	Jan. 1926	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	6.195	5.675	5.700	July 1925	150 frs.‡

* Free of British income tax. † Swiss frs. ‡ Belgian frs.